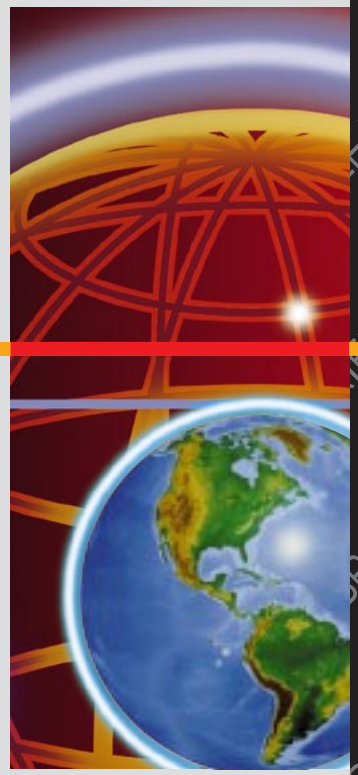
SPAWAR
Systems Center
San Diego

SSC San Diego

BRIEF



Foreword

Along with diplomatic skills and economic and military strength, information dominance is now one of the four primary instruments of national power. Information dominance means providing the warfighter sufficient and timely information and associated tools to plan and execute effectively, while denying—through both active and passive means—the enemy adequate information on which to plan and execute effectively.

The Space and Naval Warfare Systems Center San Diego (SSC San Diego) is uniquely qualified to provide the expertise and tools to achieve information dominance. We are at the cutting edge of the processes of transforming data into information, information into knowledge, and knowledge into understanding.

We have defined and articulated an integrated, futuristic vision: To be the nation's pre-eminent provider of integrated C4ISR solutions for warrior information dominance. We intend to continue and expand SSC San Diego's leadership in defining, developing, integrating, installing, and sustaining C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance) systems. This Brief summarizes our broad range of programs, capabilities, and accomplishments—a summary of our work toward achieving our vision.

Contents

Introduction to SSC San Diego

NRaD Renamed SSC San Diego—The Naval Command, Control and Ocean Surveillance Center Research, Development, Test and Evaluation Division (NRaD) was renamed the Space and Naval Warfare Systems Center San Diego (SSC San Diego) on 30 September 1997. The new title reflected the change in the Center's direct reporting responsibility from the Naval Command, Control and Ocean Surveillance Center, which was disestablished, to Space and Naval Warfare Systems Command. The change also elevated the Center to Echelon 3.

Our great strength at SSC San Diego is our unique expertise across the full spectrum of C4ISR (command, control, communications, computers, intelligence, surveillance, and reconnaissance). Our work ranges from basic research and prototype development through systems engineering and integration to life-cycle support of fielded systems. Major SSC San Diego programmatic and technical thrusts are directed toward merging advanced technology and systems into integrated C4ISR capabilities; supporting joint C4ISR needs of the military; and cooperating but not competing with industry. While most of SSC San Diego's work addresses Navy needs, we actively support Marine Corps, Air Force, Army, and Coast Guard programs. We also support other government agencies in addressing their unique C4ISR requirements.

People are critical to the successful achievement of our vision. The majority of our people are scientists and engineers, many of them with decades of experience in the Navy acquisition community. One of our most pressing current challenges is recruiting and developing the next generation of information technologists. Our organization continues to evolve to support our work across the spectrum of C4ISR.

SSC San Diego's facilities, laboratories, and fleet communications capabilities allow our engineers and scientists to replicate an operational environment unachievable in the commercial world. Only at SSC San Diego can the pieces of the overall C4ISR system be integrated and tested in both laboratory and operational contexts.

SSC San Diego is uniquely positioned geographically to perform its mission. We are close to major operational commands of the air, surface, and submarine Navy; air, expeditionary, and electronic components of the Marine Corps; the amphibious forces; and the special forces.

Our fleet support extends thousands of miles beyond San Diego Harbor and includes the SPAWAR Systems Activity in Hawaii that supports the Commander in Chief, U.S. Pacific Command, and Commander in Chief, U.S. Pacific Fleet, on-site, and the SPAWAR Systems Facilities in Guam and Japan that support the ships of the Seventh Fleet.

Mission

To be the Navy's full-spectrum research, development, test and evaluation, engineering and fleet support center for command, control and communications systems and ocean surveillance and the integration of those systems which overarch multiplatforms.

Leadership and Technology Areas

Consistent with our mission, eight leadership areas are formally assigned to SSC San Diego. These leadership areas clearly represent SSC San Diego's C4ISR charter as well as leadership areas outside that scope—ocean engineering and marine mammals. Beyond these, SSC San Diego has demonstrated national- and international-level expertise in a broad range of technology areas.

Assigned Leadership Areas

- *Command, control and communication systems*
- *Command, control and communication system countermeasures*
- *Ocean surveillance systems*
- *Command, control and communication modeling and analysis*
- *Ocean engineering*
- *Navigation systems and techniques*
- *Marine mammals*
- *Integration of space communication and surveillance systems*

Technology Areas

- *Ocean and littoral surveillance*
- *Communications and networking*
- *Topside design/antennas*
- *Command systems*
- *Computer technology*
- *Navigation*
- *Intelligence/surveillance/reconnaissance sensors*
- *Atmospheric effects assessment*
- *Marine mammals*
- *Environmental quality technology/ assessment*
- *Robotics and physical security*

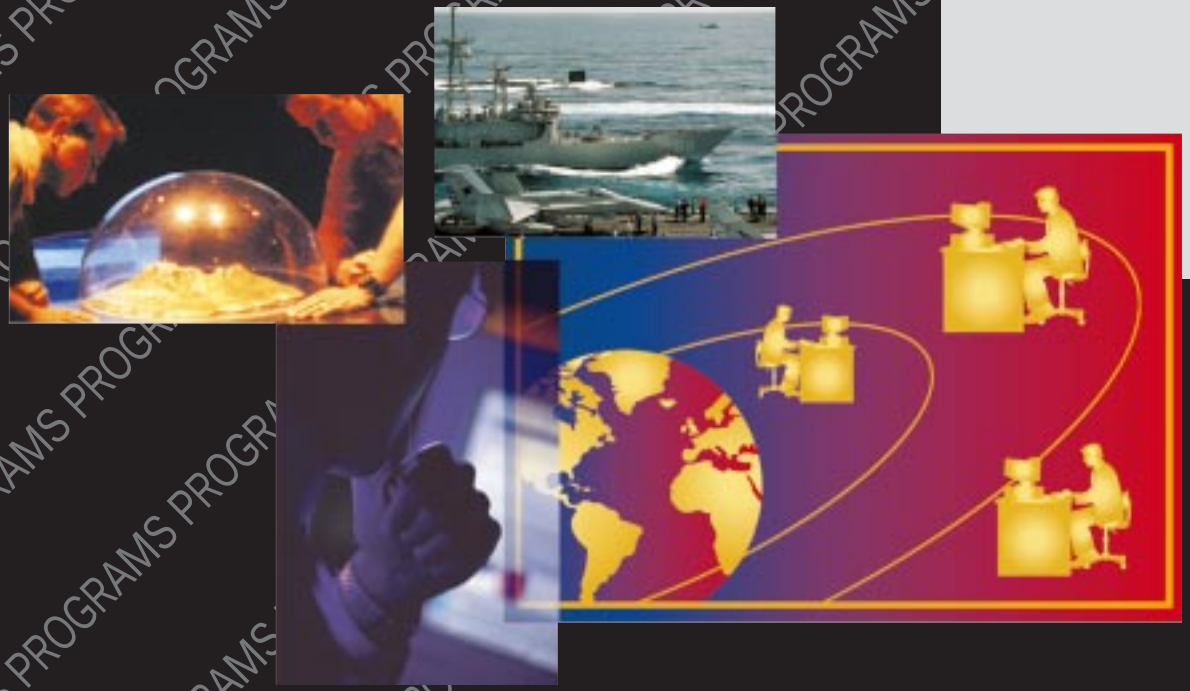
Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR)
Effective C4ISR will integrate disparate units and functions into coordinated operational capabilities.

Information Dominance
To achieve information dominance, our warfighters must have sufficient and timely information and associated tools to plan and execute effectively while denying—through both active and passive means—the enemy adequate information on which to plan and execute effectively.

Vision

Looking forward to the 21st century, the overriding goal of C4ISR must be to provide our warfighters the tools necessary to achieve information dominance over all known and potential adversaries. This goal is in concert with the operational precepts outlined in Joint Vision 2010; achieving information superiority is crucial to the full-spectrum dominance sought by our Armed Forces for the next century. SSC San Diego's vision—to be the Nation's pre-eminent provider of integrated C4ISR solutions for warrior information dominance—guides our work. Our challenge is to provide our warfighters the information technology to stay well ahead of potential adversaries and perhaps deter combat altogether.

" To be the Nation's pre-eminent provider of integrated C4ISR solutions for warrior information dominance "



Programs

SSC San Diego conducts a broad range of programs focused on integrated C4ISR. We also conduct several unique programs outside of our primary C4ISR focus. Innovative new research is encouraged through our Independent Research program. Our C4ISR programs are described on the following pages, grouped in five subsections consistent with our five Corporate Initiatives. Programs outside of our primary C4ISR focus are described in a sixth subsection: Other Programs and Research.

Our C4ISR programs focus on developing, implementing, and supporting the integrated C4ISR systems our warfighters require. Five Corporate Initiatives guide our C4ISR work. The initiatives define an evolving set of capabilities—the connectivity, information access, collaboration tools, consistent tactical understanding, and information protection—that we must incorporate in our systems to provide optimal C4ISR.

Our first initiative, *Dynamic Interoperable Connectivity*, will provide assured, user-transparent connectivity, on demand, to any desired location in the "infosphere," that is, the worldwide grid of military databases, fusion centers, national resources, and commercial information sources. Given this fundamental capability, our second initiative, *User Pull/Producer Push*, will use that connectivity to access strategically located database servers and anchor desks and provide users, at all levels, with key information. Our third initiative, *Distributed Collaboration*, will provide the tools necessary for warfighters and their commanders, peers, and subordinates to agree on a wide range of command-related issues. Our fourth initiative, *Consistent Situation Understanding*, will achieve a consistent tactical understanding of the operational situation. Our fifth initiative, *Information Operations*, will protect our information resources while denying our enemies the information needed to implement aggressive actions.

In addition to our primary C4ISR focus, we are uniquely qualified to conduct programs in several other areas vital to the Navy: environmental quality technology/assessment, marine mammals, ocean engineering, and robotics and physical security. We also encourage our scientists and engineers to explore new ideas and conduct initial research through our Independent Research program.

Dynamic Interoperable Connectivity

Dynamic Interoperable Connectivity is the conduit for all data and information, whether it moves a few feet or thousands of miles. Several features are critical to this connectivity:

- *flexibility to accommodate changing information needs;*
- *interoperability for joint, allied, and coalition operations;*
- *diversity for connectivity to military forces world wide ashore, afloat, and airborne; and to commercial entities;*
- *multi-level security; and*
- *economy—connectivity will allow sharing of resources with consequent savings over maintenance of dedicated resources for specific users.*

Joint Maritime Communications Strategy

The Joint Maritime Communications Strategy (JMCOMS) is both a technical and program strategy that implements the communications segment of the Navy's Copernicus C4I architecture. JMCOMS will implement the capability to provide tactical information to critical elements of the battle cube—the carrier battle groups and amphibious task groups—through the Battle Cube Information Exchange System. JMCOMS incorporates the latest advances in commercial and military communications technology to maximize bandwidth, enabling the sharing of information seamlessly, in real- or near-real-time, through flexible, adaptive, and interoperable systems and services. JMCOMS' rapid, reliable, and reconfigurable communications connectivity to all echelons of command and its accompanying information transfer infrastructure make the sensor-to-shooter construct a reality in the C4I environment.

The JMCOMS technical strategy consists of three elements: (1) the Automated Digital Network System (ADNS), which provides voice, video, and data applications using existing copper-wire circuits, but increases the capability of those circuits by a factor of four; (2) the Digital Modular Radio, which provides a modular, scaleable radio supporting all terminal requirements in the spectrum below 2 GHz; and (3) the Integrated Terminal Program, which provides protected low-, medium-, and high-capacity links in the spectrum above 2 GHz, using military and commercial communication systems.

The JMCOMS systems engineering team is composed of key Space and Naval Warfare Systems Command (SPAWAR), SSC San Diego, field activity, and contractor personnel focused on solving the technical challenges in designing, funding, and fielding JMCOMS elements.

Copernicus—Envisioning Global Naval Networks

The proliferation of sensor streams, different formats, protocols, organizational sponsors, complex programmatic agendas, and conflicting operational goals has made the mechanics of the military's C4I systems far too complex. In 1990, the Navy introduced an approach to solve this problem: the Copernicus Architecture. An interactive framework of pillars, Copernicus links the C4I processes of the warfighter at all echelons of command. The pillars include:

Global Information Exchange System (GLOBIXS)—ashore networks that support tactical commanders by providing access to all required information from any location through a series of wide-area Defense Communications System (DCS) networks.

Commander-in-Chief (CINC) Command Complexes (CCCs)—ashore command centers that serve as the primary gateway for communications and information flow from GLOBIXS to forward-deployed warfighter TADIXS.

Tactical Data Information Exchange System (TADIXS)—tactical networks connecting the CCCs with the TCCs.

Tactical Command Centers (TCCs)—forward-deployed command centers that disseminate information to the warfighter.

As Copernicus evolved, a new pillar emerged—the Battle Cube Information Exchange System (BCIXS). The battle cube is a conceptual, multidimensional area that includes subsurface, surface, air, and space as the environment for conducting warfare. Its essential elements are the carrier battle groups, the amphibious ready groups, and the embarked Marine Expeditionary Force. BCIXS extends the Copernicus architecture to include the battle cube.

The Copernicus Architecture continues to evolve to support Joint Vision 2010; SSC San Diego continues to play major roles in its evolution.

Antenna Development

SSC San Diego provides unique capabilities for complex shipboard topside antenna design, including antenna modeling capabilities and a one-of-a-kind arch that allows empirical testing of shipboard antennas. We are also developing the Multifunction Electromagnetic Radiating System, which combines four separate information transfer systems in one device. Another system is our Advanced Enclosed Mast/Sensor System, a composite structure that eliminates the need for a variety of antennas with their own radomes on surface ships yet provides a lower radar-cross-section profile.

Antenna Integration

SSC San Diego continues integration efforts in the areas of follow-on and next-generation antenna systems, including development of performance specifications, certification plans, test plans, and interface design descriptions, and is currently supporting procurement and integration of a lightweight antenna system. In support of the Tactical Control Systems Program, the Center is testing a KU-band satellite communication antenna that permits two-way satellite voice and data communications on board ships.

SATCOM Systems and Technologies

Satellite communication (SATCOM) is central to dynamic interoperable connectivity, providing nearly all long-haul Navy/Marine Corps connectivity, as well as over-the-horizon in-theater service. SSC San Diego programs support upgrades to existing military SATCOM systems, such as the Afloat Telecommunications Service terminal upgrade in super high frequency. SSC San Diego programs support emerging services such as extremely high-frequency and super high-frequency SATCOM, and near-term implementations such as International Maritime Satellite 'B', Television–Direct to Ship, Global Broadcast Service, and Challenge Athena. They also support novel and very successful use of seemingly outdated technology through our development of high-frequency battle force e-mail, now widely used to provide capabilities from tactical operations communications to personal e-mail to families at home.

SATCOM Foreign Military Sales

SSC San Diego has traditionally been the SPAWAR point of contact for coordinating all foreign military sales field activities in the areas of satellite communications, radio frequency engineering, installation support, engineering assistance, logistics support, training, technology evaluation and testing, and the resolution of interoperability issues. Among the countries currently being supported are France, United Kingdom, Spain, Canada, Netherlands, Greece, New Zealand, Australia, Korea, Japan, North African countries, Saudi Arabia, Germany, and Turkey.

Multiservice Internet Protocols for High-Performance Networks

Commercial resources are available to provide users on land the latest in telephone technology for high-data-rate connectivity. Our challenge is to extend asynchronous transfer mode connectivity to military deployed forces anywhere in the world, instantaneously connecting moving platforms far from home in potentially hostile environments to allow them to function as part of a coordinated C4ISR capability. SSC San Diego's Multiservice Internet Protocols for High-Performance Networks program seeks to accomplish this, providing such capabilities as line-of-sight communication links between ships of the battle force, and fax, e-mail, and video teleconferencing to carrier battle groups and amphibious ready groups off-shore and to Marines ashore.

Submarine Communications

SSC San Diego has played a leadership role in development of submarine communications for decades, providing substantial improvements in low-frequency and very low-frequency capabilities that provide connectivity between submarine forces (both tactical and strategic) and command centers ashore, afloat, and airborne. SSC San Diego submarine communications programs include development of the signal reception and distribution system for the Joint Maritime Command Information System and the Submarine Communications Support System. SSC San Diego has established C4I connectivity to a number of submarines operating with carrier battle groups through deployment of Joint Tactical Information Distribution System (JTIDS) terminals on those submarines. SSC San Diego is working to increase the number of those submarines. With that capability, the submarines can operate as a much more integral part of the carrier battle group, to the point of being able to transmit periscope imagery from the submarine to the battle group commander via JTIDS.

Joint Tactical Information Distribution System

The Joint Tactical Information Distribution System (JTIDS) is an Air Force program that provides a highly capable tactical data link. The Navy is introducing JTIDS as the new Link–16 Tactical Data Link, providing connectivity among aircraft carriers and cruisers, E-2C and F-14D aircraft, and submarines. SSC San Diego provides systems engineering support to the SPAWAR Program Executive Office for Space, Communications and Sensors (PE0-SCS).

Multifunctional Information Distribution System

The Multifunctional Information Distribution System (MIDS), a lower cost, lighter weight version of JTIDS providing connectivity among five allied nations, will connect the lead U.S. platform, the Navy and Marine Corps F/A-18 aircraft, to the link. This link will operate at higher data rates, with lower probability of intercept and greater anti-jam capabilities. SSC San Diego is the primary Navy systems engineer, supporting MIDS terminal development within the international community and its application in the F/A-18.

User Pull/ Producer Push

Programs within the User Pull/Producer Push initiative focus on the warfighter's need for sufficient information to act appropriately, but not so much that confusion results. Ready access to tactical data is vital to the warfighters, but our ability to collect this information and provide it in vast quantities can easily and quickly overwhelm the people it is intended to support. In this initiative, we envision repositories of current, pertinent information, located at anchor desks, with robust information servers to provide warfighter access to the right data at the right time.

Global Command and Control System–Maritime

The Navy's Global Command and Control System–Maritime (GCCS–M) is the third in a series of evolutionary initiatives to eliminate stovepipe command and control, intelligence, and cryptologic systems and achieve true interoperability. GCCS–M is the primary afloat and ashore C4I system for the Navy, Marine Corps, and Coast Guard.

SSC San Diego is working on interoperability with the other services through the Global Command and Control System (GCCS). Much of the technology that makes GCCS possible came from SSC San Diego's development of the afloat and ashore components of GCCS–M. SSC San Diego has the roles of software developer, system engineer and integrator, and software support activity for GCCS–M.

Global Command and Control System

The Global Command and Control System (GCCS) will provide joint and service component commanders with a set of automated tools and communications for operations planning, execution monitoring, and logistics sustainment of joint warfighting efforts. GCCS will be derived from the core system formed by the Global Command and Control System–Maritime. SSC San Diego is the systems engineering advisor and integrator of the core GCCS components.

Tactical Support Center—Mobile Variant

A critical requirement in the Navy's "Forward . . . From the Sea" philosophy is establishing command and control capabilities ashore. In several programs, such as the Mobile Integrated Command Facility (MICFAC), we have developed capabilities to project the command and control capabilities as well as personnel ashore. MICFAC, for example, will provide a completely self-contained mobile command center ashore for use at any location. These capabilities now represent mobile variants of a program called the Tactical Support Center.

Eliminating Stovepipe Systems

Stovepipe System—A system, often dedicated or proprietary, that operates independently of other systems. The stovepipe system often has unique, non-standard characteristics. Historically, systems were developed to address a specific requirement with little regard for the interrelationship with other systems or supporting infrastructure. Stovepipe systems made it difficult for platforms to share information in a timely manner, causing inefficiencies, especially in joint and allied operations.

The first major step in fielding Copernicus was implementing the Joint Maritime Command Information System (JMCIS). The JMCIS architecture links command and control systems into functional categories and creates an environment for the Services to field interoperable systems with common user interfaces.

More Navy and Marine Corps C4I systems will continue to migrate to the JMCIS architecture as Copernicus evolves. JMCIS forms a kernel of the Global Command and Control System (GCCS).

GCCS supports an open-system environment for automated information processing at all warfighting levels of the Department of Defense. The GCCS, in a departure from traditional developmental programs, promotes a rapid migration strategy that cost-effectively and continuously builds on changing technology and users' information needs.

TRAP Data Dissemination System

The TRAP Data Dissemination System (TDDS) provides near-real-time global dissemination of tactically significant data from national systems. This system evolved from requirements to test another SSC San Diego development, the Tactical Receive Equipment (based on the Tactical Data Information Exchange System–B). SSC San Diego provides concept development, design, development, system engineering, documentation, and testing. TDDS is migrating into the Integrated Broadcast Service along with other narrowband tactical systems.

Integrated Broadcast Service

The Integrated Broadcast Service was created to develop a new standardized architecture that will replace the TRAP Data Dissemination System, the Tactical Reconnaissance Intelligence Exchange System, the Tactical Intelligence Broadcast Service, and the Near-Real-Time Dissemination System and meet the warfighters' requirements for a common, unified picture of the battlefield. It will provide data to any user who needs it, at the appropriate security level, and via whatever method required.

Multi-Mission Advanced Tactical Terminal

The Multi-Mission Advanced Tactical Terminal (MATT) is a multifunctional, airborne-qualified terminal for the receipt, processing, and distribution of tactical data to multiple local users. Its function is to provide near-real-time over-the-horizon threat data directly to the warfighter for mission planning, threat warning and avoidance, and enroute retargeting. MATT receives, demodulates, and decodes near-real-time surveillance data broadcast on the Tactical Data Information Exchange System–B, the TRAP Data Dissemination System, the Tactical Information Broadcast Service, and other communications networks that employ compatible transmission characteristics. SSC San Diego continues to develop software upgrades and provide customer support to users throughout the world. MATT units are used by all of the services. MATT is being integrated into a variety of Special Operations Forces (SOF) air, ground, and surface platforms such as the MH-53J helicopter, SOF Intelligence Vehicle (SOF-IV), and Patrol Coastal. Navy aircraft employing the MATT include the EA-6B and P-3C. The Air Force is using MATT in the Combat Intelligence System and the Air Force Mission Support System. A man-tranportable "briefcase" version of the MATT is used by the Marine Corps.

Distributed Collaboration

We envision a future in which military operational organizations will be increasingly "virtual," meaning that geographically dispersed commands, from several of the Services (and, increasingly, from other U.S. federal agencies), at a number of echelons and a variety of levels within those echelons, will be called on to collaborate in the execution of a mission, but without ever meeting in the same place at the same time. Thus, SSC San Diego is developing tools for distributed collaboration, designed to enhance the warfighter's ability to conduct distributed C4ISR in a multi-echelon, multi-force environment. These tools will enable interoperability, analysis, and interactive mission planning.

COMPASS

The Common Operational Modeling, Planning, and Simulation Strategy (COMPASS) brings distributed collaborative planning and modeling and simulation services to a wide range of C4I systems at all command levels, providing interoperability among formerly incompatible systems. COMPASS provides analysis, preview, and rehearsal capabilities to transform C4I systems, including mission planning systems, into collaborative planning, rehearsal, and training systems. The ultimate implementation of the concept is to use the same "virtual battlefield" to plan, replan, simulate, or train.

Users share geo-registered and pixel-based data and discuss aspects of the mission via video teleconferencing and exchanged text. The results of individual planning sessions can then be consolidated and executed synchronously by each system to visualize interactions among friendly forces. COMPASS-capable modeling and simulation systems receive distributed interactive simulation (DIS) "shared planning" protocol data units (PDUs) so that interactions can be observed by respective planners at their own locations.

COMPASS is part of the DoD's Modeling and Simulation Master Plan and the C4I-to-Simulation Initiative. SSC San Diego provides technical oversight and project management to demonstrate advanced technology use of the DIS PDUs for enhanced use of modeling and simulation for joint C4I systems.

Joint Simulation System–Maritime

The Joint Simulation System (JSIMS) will provide a simulation environment to enable realistic joint training. It supports training in both military operations and in operations other than war, and replaces earlier technologies such as Research, Evaluation, and Systems Analysis (RESA) and the Enhanced Navy Wargaming System. JSIMS–Maritime will provide the capability to simulate maritime operations in conjunction

Developing Tools for Distributed Collaboration

SSC San Diego's Command Center of the Future—Demonstrating Future C4ISR Capabilities

The Command Center of the Future was designed and built to demonstrate, in a realistic context, future C4ISR capabilities. The center demonstrates a vision of the distributed collaboration process as it might be used in dealing with military operations or civilian natural disaster crises, or, in dealing with both simultaneously. Unique to the Command Center is the 3-D Volumetric Display System, which allows true three-dimensional visualization of digitized data.

The Navy's Maritime Battle Center—Enhancing Battlespace Capabilities for the Warfighter

The Navy's Maritime Battle Center (MBC) in SPAWAR PD-13 (Advanced Technology and Prototype Systems) is being established for the co-evolution of systems, organizations, and doctrine. It provides an environment for fleet experimentation and technology insertion and maritime systems integration and interoperability. It also serves as the maritime component of the Joint Battle Laboratory. SPAWAR's technical interface to the MBC is SSC San Diego's C4ISR Systems Integration Environment (SIE) —see the Capabilities section for more information.

USACOM Joint Training, Analysis, and Simulation Center (JTASC)—Training the Warfighter

SSC San Diego, with substantial collaboration with SSC Charleston, provided design and system engineering for the U.S. Atlantic Command's (USACOM) integrated training facility. Work included installation of command and intelligence centers, joint communications connectivity, a state-of-the-art modeling and simulation system, and video teleconferencing facilities to support operational planning and to distribute training both locally and to remote sites. SSC San Diego provides ongoing team support for the modeling and simulation component at JTASC.

with JSIMS core services and components that represent land, air/space, intelligence, and C4I.

The maritime components will satisfy Navy requirements and allow Unified Commander-in-Chief/Designated Commander Joint Task Force commands to interface with operating forces. SSC San Diego is system engineer and developer of JSIMS–Maritime.

Common Object Framework

The Common Object Framework (COF) project is evolving from a technology demonstration based on the Common Object Request Broker Architecture. It uses object request brokers to function as "middleware," allowing disparate applications and systems to talk and link together. COF facilitates battlespace awareness; indications and warning; and collaborative mission planning. It successfully integrates time-sensitive operational and intelligence data to provide a common picture to both operators and analysts in a familiar and comfortable format. Key principles of COF include commercial and government off-the-shelf product re-use; distributed environment; near-real-time facilities and capabilities; scalability for both mission and platform (a plug-and-play capability); transportability to other platforms.

Consistent Situation Understanding

Our fourth initiative, Consistent Situation Understanding, focuses on developing a shared understanding of the "operational picture," or common operating picture, across all command levels. This understanding is formed from many information resources. It involves sensors to collect tactical data, data fusion capabilities, the ability to interpret the information/situation, and the means to share the information as appropriate.

The Consistent Situation Understanding initiative has three main thrusts. The first thrust is the development of new sensors to gather more data. The second thrust is the fusion of intelligence, surveillance, and reconnaissance data to produce the common operating picture. The third thrust is real-time management, display, and dissemination of the common operating picture.

Sensors and Unmanned Systems Development and Integration

Networks of sensors and unmanned systems offer the military enormous potential for risk and cost reduction. Technology developments in unmanned aerial vehicles, unmanned undersea vehicles, and unmanned ground vehicles, as well as a large variety of individual intelligence, surveillance, and reconnaissance sensors provide our warfighters with unprecedented capabilities for information dominance. Each comprises a system within the aggregate of C4ISR systems; each gives access to information needed for consistent situation understanding. SSC San Diego is developing ways to integrate the information from these systems into the tactical picture. As an important subset to ongoing SSC San Diego C4ISR efforts, sensors and unmanned systems are being integrated into the Navy's tactical systems.

Unmanned Aerial Vehicles

Unmanned aerial vehicle (UAV) technology has matured sufficiently to make UAVs an indispensable C4ISR tool for the warfighter. UAVs provide a relatively inexpensive, low risk, and, by virtue of their small size and slow speed, covert means of advantageously positioning sensors in the battlespace. SSC San Diego is exploiting these capabilities to ensure that the sensor packages and data and the command and control links are fully integrated with Navy tactical systems, both ashore and aboard ship. SSC San Diego is also working to provide appropriate dissemination of data from the UAV control station(s) to the warfighters.

Unmanned Undersea Vehicles

Missions that will require future military unmanned undersea vehicle (UUV) systems include surveillance, intelligence collection, tactical oceanography, special warfare, counter-narcotics, and counter-terrorism, with mine countermeasures being

identified as the most critical. SSC San Diego continues to develop technology and systems that support the military requirement for UUVs, including general vehicle developments, command and control systems, fiber-optic and acoustic communication links, non-metallic materials, and launch and recovery systems. In addition, SSC San Diego provides technical support to high-priority Navy UUV programs including the Near-Term Mine Reconnaissance System and the Long-Term Mine Reconnaissance System.

Tactical Sensors

The Tactical Sensors Program will develop small-unit warfare concepts of operations that include smaller, more capable forces widely dispersed throughout the battlespace. SSC San Diego performs and coordinates technology analyses that focus on comprehensive awareness, tactical sensors, real-time tasking and control of assets, robust communications, and an integrated grid of battlespace. Example programs include Internetted Unattended Ground Sensors (IUGS), Micro-IUGS, Counter-Sniper, and Low-Power Integrated Weapon Sight.

Internetted Unattended Ground Sensors (IUGS). The IUGS program will provide high-precision unattended ground sensors that incorporate greatly enhanced sensor algorithms and new sensors to provide a significant tactical advancement in target classification and tracking.

Micro IUGS. The Micro-IUGS program will develop miniature, low-power, affordable, unattended acoustic, magnetic, seismic, chemical, biological, imaging, and environmental sensor systems that can be used singularly or internetted together to provide significant detection, localization, and classification advantage for ground forces.

Counter Sniper. The Counter Sniper program will provide a low-cost, low-power, and ruggedized family of variant acoustic and/or electro-optical counter sniper systems that can detect, localize, and identify small and large caliber arms.

Low-Power Integrated Weapon Sight. The Low-Power Integrated Weapon Sight program will provide a long-range (7 to 10 km) precision targeting small-unit operations (SUO) system that will include a thermal imaging system, a low-power laser rangefinder, a high-precision digital compass, a high-precision Global Positioning System, and video transmission, and is intended to be integrated on many SUO-related platforms.

Electro Optical/InfraRed and Hyperspectral Imaging Systems

Littoral Airborne Sensor/Hyperspectral (LASH). The LASH program was established to provide Fleet/Fleet Marine Force evaluation of hyperspectral technology for the detection of submarines, shallow water/very shallow water/surf zone mines, and other littoral targets. The current approach is to provide a complete characterization and field evaluation of LASH for antisubmarine warfare. The hyperspectral mine detection data obtained will be used to support engineering analysis and design of a UAV-based LASH–Reconnaissance system, which will also be built and evaluated.

SSC San Diego's Surveillance Department is the lead program manager for LASH; SPAWAR Systems Center Pacific plays a major role in the development of the integrated logistical support plan and the operator and maintenance training plans.

Laser Intelligence Collection Sensors. The Laser Intelligence Collection Sensors program develops, tests, calibrates, and deploys electro-optic sensors to detect direct and indirect laser illumination and obtain high-value measurement and signal intelligence information to determine critical parameters of threat laser systems and to support multiple missions including real-time warning, threat identification, and countermeasure development.

Chokepoint Surveillance. The Chokepoint Surveillance program will provide the Navy with long-range electro-optic surveillance systems capable of round-the-clock operations using high-resolution cameras, intensified cameras, multi-focal-length lenses, range-gated television, and video enhancement.

Starring InfraRed. The Starring InfraRed program is driven by the operational requirement of ship point defense against sea skimming cruise missiles. The main objective is to demonstrate automatic passive detection and tracking of threats at sufficient range to enable the combat system to respond, ensuring high probability of kill.

Advanced Sensor Applications. The Advanced Sensor Applications program is investigating the application of electro-optical laser range-gated and time-resolved light detecting and ranging technology and hyperspectral imaging systems as applied to seeing through the air–water interface to detect objects in the water volume or on the bottom. Missions include non-acoustic antisubmarine warfare littoral and open-ocean environments with special emphasis on semi-enclosed seas, choke points, and bastions.

High-Frequency Surface Wave Radar

SSC San Diego's Advanced Technology Demonstration (ATD) project for development of a shipboard high-frequency surface wave radar will provide increased warning time for surface ships against low incoming threats—anti-ship missiles and aircraft. Current microwave radar technology allows detection only to the horizon. The ATD system will extend detection range to about 40 kilometers (25 statute miles) for anti-ship missiles and 80 kilometers (50 miles) for low-flying aircraft. Delayed in FY 97 by Navy ATD funding cuts, the program will be completed by March 1999. Testing on the Self-Defense Test Ship will begin in December 1998.

Undersea Surveillance

SSC San Diego has been a major participant for decades in the development of fixed, deployable, and mobile surveillance capabilities to detect and track submarines. During the Cold War, we focused those efforts on specific targets—Soviet nuclear submarines operating in deep water—and we achieved success with such systems as the Surveillance Towed Array Sensor System and Low Frequency Active. Our current challenge is to develop similar capabilities to track diesel–electric submarines operating in the littoral areas—a quieter platform operating in a much more complex sonar environment.

Integrated Undersea Surveillance System

The Integrated Undersea Surveillance System (IUSS) consists of fixed, mobile, and deployable acoustic arrays that provide vital tactical cueing to antisubmarine warfare forces. IUSS is a model for innovation and the smart use of technology. Workstations, enhanced signal processing, and modern communication technologies enable remote array monitoring, thereby reducing personnel requirements and improving efficiency.

Advanced Deployable System

SSC San Diego provides engineering support for all aspects of the Advanced Deployable System (ADS). ADS is a theater-deliverable acoustic surveillance system that will provide continuous acoustic coverage over vast ocean areas for an extended period. ADS will be capable of detecting quiet nuclear submarines, diesel–electric submarines on the battery, ships exiting or entering harbors, or mine-laying operations. The importance of this portable capability will intensify as our surveillance requirements increase, owing to the Navy's focus on the littorals, the worldwide dissemination of diesel submarines, and the downsizing of our own forces.

Deployable Autonomous Distributed Sensors

The Deployable Autonomous Distributed Sensors program will extend knowledge and control of the undersea battlespace through the development of clandestine off-board sensors. Autonomous distributed sensors will provide the joint force commander with surveillance options in areas where current and projected capability is either too costly, too overt, too slow to deploy, or limited by the number of manned platforms available.

Tactical Cryptologic Systems

SSC San Diego performs systems engineering, software development (integration), and test and evaluation of tactical cryptologic systems to detect, identify, and exploit signals of interest for a variety of missions. Primary current tasking is the development of Cryptologic Unified Build software configurations for the Joint Maritime Command Information System.

Standard TRE Display

The Standard TRE Display (STRED) is a low-cost tactical display processor that processes and displays Tactical Data Dissemination System, Tactical Data Information Exchange System–B, and Tactical Information Broadcast Service contact reports. STRED operates on commercially available Intel-based computers with Windows and NT operating systems and is Defense Information Infrastructure Common Operating Environment (DII COE) (Level 5) compliant. The newest module Tactical Receive Segment replaces Tactical Receive Equipment (TRE) OL-444 and has been designated as the first operational Common Integrated Broadcast Service Module, extending the useful life of existing tactical terminal radio equipment.

Tactical Jammers

The Marine Corps Radio Battalions require versatile, lightweight, tactical jammers for their radio reconnaissance teams. Traditional high-power, broadband, barrage jammers in the inventory are not appropriate for their missions. SSC San Diego is developing a smart tactical jammer that combines smart waveforms with reactive jamming to minimize jamming power and maximize covertness, and a family of low-cost, lightweight, expendable jammers. These jammers will provide capability against emerging commercial wireless systems.

Rapid Imagery Intelligence Transmission

Rapid Imagery Intelligence Transmission (RIT) is a multi-phased effort to improve production, dissemination, and display of time-critical textual information exploited from national, theater, and tactical imagery sources. SSC San Diego has installed RIT at Joint Intelligence Center (JIC) Pacific, is awaiting installation at the European Command JIC, and has conducted exercise and demonstration support deployments for Marine Corps, U.S. Forces Korea, Air Force, Army, and Pacific Command users.

db MASTER Intelligence Analyst Application

db MASTER software provides the intelligence analyst with improved methods for sorting, examining, and fusing discrete information from a wide range of intelligence sources. SSC San Diego has designed db MASTER to provide the intelligence analyst/specialist with tools that significantly enhance the ability to search a variety of intelligence database sources from a single workstation. The db MASTER software provides the analyst with an intuitive, user-friendly, graphical interface to three major intelligence databases, National Imagery and Mapping Agency digital maps, and a variety of hard-copy intelligence reference materials.

Family of Integrated Tactical Security Sensor Systems

In recent years, military security forces have operated in a climate of increasing mission complexity and diversity. In response to such challenges, the U.S. Army Training and Doctrine Command approved a concept for a Family of Integrated Tactical Security Sensor Systems to support future operations. In support of this concept, the Defense Special Weapons Agency initiated two exploratory development projects at SSC San Diego to develop an Advanced User Interface for Tactical Security (AITS) and a Tactical Sensor Internetting and Integration (TSSII) capability. These projects are complementary in approach and application. AITS addresses the human factors and display technologies needed to effectively maximize information presentation to the warfighter in a clear, intuitive manner, while TSSII is focused on architecture-based, commercial off-the-shelf components and emerging Internet standards to provide flexible networking for a scalable system that will support control of and communication with multiple tactical sensors.

NAVSTAR Global Positioning System

Precise navigation information is critical to situation perception. SSC San Diego is the Navy leader for navigation support, and performs research and development for all the services' Global Positioning System (GPS) receivers. GPS is a space-based radio-positioning and time-transfer system consisting of a constellation of 24 satellites. SSC San Diego plays the leadership role for the user segment of GPS and provides software support for GPS receivers for Tomahawk.

Navigation Sensor System Interface

The Navigation Sensor System Interface (NAVSSI) is a shipboard navigation processor designed to integrate shipboard navigation sensors and systems and distribute a central source of highly accurate real-time navigation and time data to combat, combat support, and communication systems. NAVSSI also provides an electronic navigator's workstation to support safe navigation using digital nautical charts that will be replacing paper charts. NAVSSI is currently deployed on over 60 surface combatants, and there are plans to install it aboard another hundred.

Ocean Survey Program Survey System

The Ocean Survey Program Survey System (OSPSS) is a shipboard survey system designed to produce ocean bottom (bathymetric) contour charts for direct use by the Trident Fleet Ballistic Missile Program. OSPSS consists of a precise navigation subsystem and wide swath sonar array subsystem integrated with an advanced data processing subsystem. SSC San Diego has implemented a continuous program to extend the capability, accuracy, reliability, and maintainability of these systems by advancing the state-of-the-art in navigation, sonar, and data

enhancement techniques in response to increasingly stringent fleet requirements for bathymetry, gravity, magnetic, and other geophysical parameters.

Tactical Decision Making Under Stress

The Tactical Decision Making Under Stress program seeks to improve the human–computer interface, both by enhancing computer capabilities to provide information to the warfighter in a more efficient, more comprehensible manner, and by improving the training and behavioral responses of the warfighters to the information provided.

This program had its origin in two Navy disasters—the attack of an Exocet surface missile on the USS *Stark* (FFG 31), and the USS *Vincennes* (CCG 49) shootdown of the Iranian airbus. These incidents emphasized the life-and-death importance of information accessibility to the warfighter, both in terms of the format in which the information is presented and the methodology employed by tactical decision-makers to employ the available information wisely.

Advanced Combat Direction System

The Advanced Combat Direction System is the shipboard hardware and software upgrade of the Naval Tactical Data System (NTDS). Using data provided by onboard sensors and other digital interfaces that include Joint Tactical Information Distribution System/Link–16, ACDS provides a significant order-of-magnitude improvement in AAW, ASW, and ASUW (anti-air warfare, antisubmarine warfare, and anti-surface warfare) target acquisition, tracking, and engagement capabilities. (NTDS provided about 250 simultaneous tracks.)

When first fielded on carriers, large amphibious assault ships, and non-Aegis cruisers, ACDS provided a significant increase in track capacity and other command and control capabilities. Plans to further increase capacity/other capabilities continue as we evolve into the 21st century. (Upgrades to 10,000 tracks are being considered.)

Following the ACDS equipment upgrade in CV/CVN (carriers) class ships, the ACDS Block 0 tactical computer program was provided as the initial replacement to NTDS. Block 0 was provided as additional CV/CVN, LHD 1 (multipurpose amphibious assault), and LHA 1 (general-purpose amphibious assault) class ships were upgraded. As Block 1 becomes available, it will be used to replace the Block 0 program on selected CV/CVN and LHD class ships. In consonance with the Model 5 Command and Control Processor/Joint Tactical Information Distribution System capability, ACDS Block 1 provides significant enhancements in sensor management, tactical data exchange, and warfare area coordination. Another significant enhancement to these ships is Block 1's Cooperative Engagement Capability interface.

Information Operations

Increasingly, potential adversaries can attack data (information) within databases, computers, communications links, and sensors. Information systems are vulnerable. For dominance in the information domain, we must protect our own information resources and be prepared to both affect and exploit an enemy's.

SSC San Diego's focus in supporting the Department of Defense information warfare effort is the research, development, test, and evaluation of features of the information infrastructure, including automated information systems such as C4 systems that serve the needs of the National Command Authority and operating forces under all conditions of peace and war. Within the total information environment, the information infrastructure includes the aggregate of individuals, organizations, and systems that collect, process, or disseminate information, including the information itself.

Automated Information Systems Security Assist Team

SSC San Diego's Automated Information Systems Security Assist Team performs site surveys on ships, first determining the configuration of local-area networks (LANs) and LAN resources, and then determining network architecture and modifications required to make the system more secure. Team members then develop hardware and software solutions and install necessary products to ensure a higher level of security and to prevent contamination of databases, both from within the system and by attacks from outside, while at the same time ensuring proper information flow. In addition to the protection process, the team also "cleans up" network architectures to make them easier to maintain.

Satellite Communications Vulnerability

Navy satellite communications are vulnerable to detection, interception, and transmitter geolocation during signal transmission. SSC San Diego is studying the vulnerability of Navy ships to signal interception and exploitation, with a goal of mitigating the effects of these techniques. At the same time, we are interested in studying these techniques to improve our own signal-exploitation capabilities.

Intrusion Detection, Assessment, and Recovery

Intrusion Detection, Assessment, and Recovery is a joint SSC San Diego–Naval Research Laboratory effort directed at developing decision aids to support prevention of and reaction to information warfare attacks. Attack reports generated by detectors will be employed to project which end-user information products are likely to be affected if corrupted data propagates through a computer network. Decision-makers can then be advised when the quality of information products is suspect, while the Command and Control Warfare Commander and system managers can be better advised about information systems status in order to conduct recovery.

SSC San Diego's Information Operations Center of Excellence

—BRINGING INFORMATION WARRIORS TOGETHER WITH CONCEPTS AND TECHNOLOGIES TO EXCEL IN INFORMATION OPERATIONS

SSC San Diego's Information Operations Center of Excellence (IOCOE) *was established to develop integrated strategies, concepts, and services; identify, assess, and demonstrate current and future technologies in an integrated, operationally valid environment; and, provide a "neutral" technologically sophisticated environment for helping operators with information operations policies and doctrine.*

A key component of the IOCOE will be the Information Operations Center of the Future (IOCOF), a flexible, modular facility able to incorporate emerging technologies, development programs, and real-world challenges into a common environment. The IOCOF will

- *Facilitate information operations wargames and exercises*
- *Provide education and training for information operations needs*
- *Provide a focal point for information operations activities at SSC San Diego to support interaction with external developers and agencies*
- *Provide operators and acquisition managers the opportunity to "touch and feel" information operations in a forward-looking environment*

With the goal of bringing information warriors together with concepts and technologies to excel in information operations, the IOCOE enhances the Center's participation in both Navy and joint information operations activities. Looking ahead to the 21st Century, the IOCOE is expected to serve as a highly recognized forum and facility for information operations technology, doctrine, and requirements definition throughout the information operations community.

Location of GPS Interferers

The U.S. is increasingly turning to the Global Positioning System (GPS) as its precision navigation system. SSC San Diego is developing the Location of GPS Interferers (LOCO GPSI) system to help combat the emerging threat of low-cost GPS jammers. LOCO GPSI is a short-baseline, interferometer-based system capable of direction finding on and locating these GPS jammers. The system is small enough to be widely applicable to aircraft, including unmanned airborne vehicles.

Other Programs and Research

SSC San Diego employs nationally and internationally recognized experts working to improve the Navy's capabilities in several other areas: Environmental Quality Technology/Assessment, Marine Resources, Marine Mammals, Ocean Engineering, and Robotics and Physical Security. In addition, Independent Research programs support innovative ideas proposed by SSC San Diego scientists and engineers.

Environmental Quality Technology/Assessment

Marine Environmental Survey Capability (MESC). Historically, our undersea surveillance efforts have required substantial scientific research in chemical oceanography. Our expertise in that area led to development of the MESC, a small craft providing a unique technology for on-site, real-time water quality assessment in coastal and estuarine environments. It is used to assist the Fleet in detecting potential pollution sources and in the identification of the chemical composition of that pollution.

Site Characterization and Analysis Penetrometer System (SCAPS). SSC San Diego has adapted its environmental technology to the assessment of hazardous waste sites on land. One of the requirements for turnover of a military base to a community or civic organization is return of the land to "pristine condition." That often requires an expensive, time-consuming process of identifying long-unused and forgotten hazardous waste dumping sites. SCAPS makes the previous detection method of digging large holes at suspected hazardous waste sites unnecessary. The SCAPS probe punches a small hole ($1\frac{1}{4}$-inch diameter) in the ground, fluoresces the soil through a sapphire window, with the return transmitted up the fiber to a support truck, where spectrum analysis determines the nature and concentration of pollutants such as petroleum-oil-lubricants. With polluted sites identified, SSC San Diego can support site remediation. One of our major technology transfer successes, SCAPS has been widely adopted throughout the country for hazardous waste detection.

Living Marine Resource Information System

SSC San Diego is designing and developing marine animal databases urgently needed by the Fleet. The Living Marine Resource Information System (LMRIS) provides monthly occurrence data for those marine species of most concern to the Fleet through a platform-independent graphical user interface. SSC San Diego is designing and demonstrating a marine animal impact assessment and mitigation capability,

the System for Mitigation and Assessment of Risk Toolset (SMART). SMART supplements the LMRIS occurrence data with marine animal audiometry, source signal characterization, and propagation modeling to provide the ability to assess and mitigate risk of Fleet sonar operations on protected marine animals.

Marine Mammal Program

SSC San Diego manages the Navy's Marine Mammal Program, maintaining a cutting-edge research program and managing four operational systems employing marine mammals: Pingered Object Recovery, Swimmer Defense, and two Mine Countermeasures systems.

Pingered Object Recovery. This system employs California sea lions for recovery of objects placed on the sea floor. Sea lions do not have the remarkable sonar capability well known in dolphins, but they have exceptional underwater directional hearing and low-light-level vision. We use this capability by placing a sound source, a pinger, in an object to be placed on the bottom and later located and recovered. When recovery is desired, a sea lion carrying a grabber device swims to the bottom, attaches the grabber, and swims back to the surface, leaving a line attached for recovery.

Swimmer Defense. SSC San Diego also maintains a bottlenose dolphin system providing swimmer defense in a manner similar to use of a guard dog at a land base, with the dolphin notifying his handlers of an intruder so they can apprehend the intruder. This system was deployed to Vietnam in 1970 and 1971 to protect the ammunition pier at Cam Ranh Bay, and again to the Persian Gulf in 1987–1988 to protect the Third Fleet flagship anchored in Bahrain. The system was also on standby at the request of the Secret Service during the 1996 Republican convention in San Diego, ready to provide a defense against a terrorist attack on the convention center, which is on San Diego harbor.

Mine Countermeasures (MCM). SSC San Diego developed and now provides in-service engineering agent, depot, and veterinary support to two mine hunting Fleet Marine Mammal Systems (MMS) assigned to Explosive Ordnance Disposal Mobile Unit Three. The Mk 4 MMS is a tethered mine hunting system and the Mk 7 MMS is a bottom mine hunting system that provides the only buried mine detection asset to the U.S. Navy. These MMS can be deployed by aircraft and have been enhanced to operate from amphibious ships. SSC San Diego is currently developing the EX 8 MMS as an ACAT IVT to provide a pre-assault MCM in very shallow water. Initial Operating Capability for this system is scheduled for FY 01.

Ocean Engineering

As a leadership area assigned to SSC San Diego by the Assistant Secretary of the Navy (Research, Development and Acquisition), ocean engineering at SSC San Diego covers the full spectrum of system acquisition from technology development through fleet support. This includes accelerated development and test and evaluation of emergent fleet requirement systems and hardware. Programs have included deployment and at-sea test and evaluation of undersea surveillance systems; the development of unmanned undersea systems and related technologies, including propulsion systems, non-metallic materials for viewports and pressure housings, underwater fiber-optic and acoustic communications links, and launch and recovery systems; and the in-service engineering, maintenance, and upgrades of manned and

unmanned fleet assets (including Deep Submergence Rescue Vehicle, Deep Submergence Vehicle, Advanced Tethered Vehicle, and USS *Dolphin*).

Mine Neutralization System (MNS). SSC San Diego provides engineering and management support for the AN/SLQ-48(V) MNS, including the unmanned, tethered Mine Neutralization Vehicle.

Robotics and Physical Security

Waterside Security System (WSS). The WSS is an integrated, multiple-sensor security system that automatically detects and tracks waterborne targets, identifies and alerts on all threats, and aids in threat assessment and response. SSC San Diego identifies, tests, and evaluates commercially available physical security equipment having application to force protection at waterside facilties worldwide and provides engineering support to systems transitioned to the Fleet. Preplanned product improvements include a rapidly deployable configuration; uncooled thermal imagers; PC-based command, control, and communications; display element; and floating barriers.

Mobile Inshore Undersea Warfare–System Upgrade (MIUW–SU). The MIUW-SU is an upgrade program for the Naval Reserves that provides enhanced surveillance and communication capabilities for port security, harbor defense, and coastal warfare missions. The rapidly deployable system consists of mobile radar and imaging platforms, underwater acoustic sensors and processing, electronic support measures, and tactical communications equipment. SSC San Diego is design agent, production agent, and in-service engineering agent for development, production, and follow-on fleet support.

Mobile Detection Assessment Response System (MDARS). MDARS is a joint services effort to provide an automated intrusion detection and inventory assessment capability for DoD warehouses and storage sites using multiple coordinated internal and external robots. SSC San Diego provides technical support for the MDARS program, acting as the Technical Director, System Integrator, and Software Developer. SSC San Diego has developed the Multiple Resource Host Architecture (MHRA) to allow the control of multiple robots, sensors, and other devices simultaneously. MRHA software was developed in Ada and employs the Windows NT operating system.

Independent Research

New and innovative ideas proposed by SSC San Diego scientists and engineers are supported with discretionary funding provided by Independent Research programs. These programs support initial research in many areas of interest to the Navy. See the Accomplishments section for more information.

Capabilities

SSC San Diego has superb capabilities—physical and virtual facilities and laboratories, distributed test beds, high-performance computers and networks, worldwide communications connectivity—for conducting RDT&E and providing life-cycle support in C4ISR. SSC San Diego's unique capabilities allow our scientists and engineers to replicate an operational environment unachievable in the commercial world. Specific SSC San Diego capabilities are described on the following pages, grouped by major areas of effort.

In San Diego, our facilities occupy more than 580 acres. Facilities are concentrated in four major areas: Topside, Bayside, Seaside, and Old Town. Topside facilities, located on the ridge of Point Loma, include the principal administrative and support sections, as well as facilities for communications, environmental testing, electronic materials, advanced electronics, laser technology, and ocean surveillance. Our Bayside facilities face San Diego Bay, which provides waterfront access and berthing capabilities vital to SSC San Diego activities in ocean surveillance, ocean engineering, navigation, and marine sciences. Seaside facilities are located on the west slope of Point Loma, which offers a protected, electromagnetically shielded site essential to RDT&E in C3I and ocean surveillance. The Old Town Campus houses work areas for the fabrication of electronic hardware supporting SSC San Diego's C4ISR programs. The Old Town Campus also became the headquarters of Space and Naval Warfare Systems Command on 1 October 1997.

Our Hawaii Activity and its two western facilities in Guam and Japan provide electronic systems engineering support to Navy and Marine Corps and joint service component forces in the Western Pacific and Indian Oceans.

Our communications connectivity allows most of the Navy's C4ISR systems to be interconnected to support developmental testing as well as to participate in live operations with U.S. Fleet units. SSC San Diego's total capability allows us to provide and manage rapid reconfiguration of our C4ISR capabilities and to provide national and international connectivity using commercial and military capabilities in support of primary mission areas.

C4ISR Systems Integration Environment

The C4ISR Systems Integration Environment (C4ISR SIE) is the Navy's premier C4ISR integration and test facility. The C4ISR SIE exploits current technology to realize cost-effective and timely integrated systems development and implementation. A distributed environment consisting of existing laboratory facilities, systems, and core personnel, the C4ISR SIE supports life-cycle acquisition, supports system integration and test, and assures cost-effective implementation of integrated, joint, and interoperable naval C4ISR systems. The C4ISR SIE pursues four main objectives:

- *Support C4ISR from initial concept to end of life.*
- *Provide a collaborative engineering environment supporting technology insertion, concept development, architecture development, system-of-systems integration and test, systems interoperability, program manager's systems integration and test and experimentation/demonstration.*
- *Provide a reconfigurable and scalable C4ISR test capability by interconnecting existing SPAWAR facilities and labs and by interfacing with external facilities and labs.*
- *Serve as SPAWAR's technical interface to the Navy's Maritime Battle Center.*

Supporting these objectives is an extensive database of C4ISR capabilities and dedicated personnel to coordinate tests. The Scheduling and Engineering Tool (SET) is a current database of laboratories, systems, schedules, equipment, programs, and connectivity. The database is used to mitigate scheduling conflicts, to coordinate events, and to provide the collaborative engineering environment needed to produce fully integrated systems before they are deployed. SET currently provides data for over 283 labs and facilities. While the database is available to the general C4ISR community, the C4ISR SIE's experienced Lead Systems Engineers offer expert assistance in organizing and executing tests, enabling the best possible use of C4ISR test capabilities.

The importance of the C4ISR SIE to the maritime C4ISR community lies in its integration capabilities—by facilitating integration across product lines, the C4ISR SIE contributes to the maritime system-of-systems capability, in turn enhancing battlespace capabilities for the warfighter.

C4ISR

Advanced Virtual Intelligence, Surveillance, and Reconnaissance Laboratory

The Advanced Virtual Intelligence, Surveillance, and Reconnaissance (ADVISR) laboratory, in development at SSC San Diego, is a distributed interactive simulation and future high-level-architecture compatible, physics-based simulator capable of modeling sensors, communications, and command and control systems. ISR system life-cycle costs can be minimized by evaluating system concepts and architectures in simulation and by testing complex systems in virtual environments prior to prototype development.

Reconfigurable Land-Based Test Site

The Reconfigurable Land-Based Test Site, a versatile integration interoperability test center, takes advantage of the variety of systems available at SSC San Diego and provides connectivity to operational tactical networks as well as development laboratories to configure interoperability tests that accurately reflect real-world operations in a controlled environment.

Advanced Combat Direction System Laboratory

The Advanced Combat Direction System (ACDS) Laboratory provides the primary development and testing facilities for the ACDS Block 0 and Block 1 programs and the Command and Control Processor (C2P). This laboratory complex provides a partial suite of legacy military computers and peripherals in a readily reconfigurable environment that can simulate many platform configurations for test of new programs or for troubleshooting of previously delivered Combat Direction System or C2P programs.

ACDS Staging Facility

The ACDS Staging Facility is a joint Program Executive Office Theater Air Defense–SSC San Diego project in support of the LHA-1 (general-purpose amphibious assault ship) class ACDS upgrade effort. It was developed as a reconfigurable system integration and grooming site. The Staging Facility provides ACDS engineering and installation teams an environment to work together in support of ensuring that a mature system is installed on board warfighting ships. The staging and integration process continues to allow for actual ship's components to be installed and integrated into a working system prior to their transfer to the shipyard for actual shipboard installation.

Command and Control Advanced Research Network

The Command and Control Advanced Research Network (CCARnet) is a backbone network service for classified and unclassified, high-bandwidth, high-speed, multimedia (voice, audio, digital data) internetworking between SSC San Diego Command and Control Department spaces located throughout the Point Loma campus. CCARnet also provides connectivity to other SSC San Diego or tenant activity laboratories and wide-area connectivity to other networks.

CDES Site

The Combat Direction System (CDS) Development and Evaluation Site (CDES) is a multiconfigurable development center and provides the facilities, equipment, and system engineering capability for the development of new or upgraded ship combat direction systems.

Distributed Command and Control Laboratory

The Distributed Command and Control Laboratory provides hardware, software, and communications connectivity to support the development and application of distributed processing technology to command and control systems.

DSI Advanced Simulation Laboratory

The Distributed Simulation Internet (DSI) Advanced Simulation Laboratory (DASL) provides secure DSI integration hardware, software, simulations, and gateways to other simulations.

The mission of the DASL is to support the use of advanced distributed simulation to create virtual environments to support command and control, training, system acquisition, and test and evaluation missions. Research is oriented toward simulation internetting of heterogeneous live and synthetic simulation and simulators. Work involves supporting the evolution of standard distributed interactive simulation protocols both in concept and through software prototype implementations.

GCCS–M Ashore Integration and Test Facility

The Global Command and Control System-Maritime (GCCS–M) Ashore Integration and Test Facility provides hardware, software, and communications for application development, integration, and compliance, functional, and interoperability testing in support of ashore command systems.

GCCS–M Afloat Test Bed and Integration Facility

The GCCS–M Afloat Test Bed and Integration Facility provides mockups of the installations on aircraft carriers, command ships, and unit-level platforms to support application development, integration, and compliance, functional, and interoperablilty testing.

Systems Integration Facility

The Systems Integration Facility is used for testing and integrating Joint Tactical Information Distribution System terminals with aircraft data systems and shipboard combat direction systems, and for testing the interoperability of Link–16 systems.

JMCOMS Simulation Facility

The Joint Maritime Communications Strategy (JMCOMS) Simulation Facility provides an environment for evaluating software components being developed for communication control systems; analysis includes fleet protocol definition, operator interfaces, and system engineering.

High-Data-Rate Mobile Internet

High-Data-Rate Mobile Internet (MONET) is a test bed for high-data-rate tactical communication technologies. MONET will incorporate new applications using commercial standards such as asynchronous transfer mode and the Synchronous Optical Network high-data-rate military radios, and Department of Defense and commercial satellite communication links.

Modeling and Simulation Operations Support Cell

The Modeling and Simulation (M&S) Operations Support Cell (MOSC) provides a single point of contact for information requests, analyses, and decision support for planners using C4I systems. MOSC is the first of several operations support cells that will be embedded in the M&S Operational Support Activity.

SHF SATCOM

The SHF SATCOM Test Facility contains a complete super high frequency (SHF) satellite communications terminal and test equipment to support follow-on SHF equipment development.

The mission of the SHF SATCOM Test Facility includes providing earth terminal support for RDT&E missions using the Defense Satellite Communication System (DSCS), extending these data communication services to users via either leased landlines or the Timeplex campus network, and coordinating satellite access with the DSCS Network Manager at the Defense Information Systems Agency, Washington, DC.

The facility consists of two earth terminals. The East earth terminal provides access to one of three DSCS satellites: the West Atlantic, East Pacific prime (EPAC), and East Pacific spare (EPAC spare) satellites. The West earth terminal provides access to one of four DSCS satellites: the EPAC, EPAC spare, West Pacific prime, and West Pacific spare satellites.

Ship Antenna Model Range

The Ship Antenna Model Range allows simulation and modeling of ship communications, consisting of ground planes, model ships, track, towers, control systems, test equipment, data collection systems, data-reduction computers, and analysis software and components.

Ship Antenna Simulation Facility

The Ship Antenna Simulation Facility operates with the Ship Antenna Model Range to provide software modeling and simulation of systems, confirmation of models, and extensions beyond the test capability of the model range.

Acoustic Systems and Technology Analysis and Research Laboratory

The Acoustic Systems and Technology Analysis and Research Laboratory provides both in-house and at-sea multistatic active acoustic signal-processing capabilities via a network of workstations and associated programs. Capabilities include the standard functions of demodulator, matched filter, beamformer, threshold, signal displays, and multistatic geographic situational displays, plus interface advanced algorithms such as adaptive beamforming, coherent inter-ping reverberation suppression, and adaptive Doppler processing. For in-house use, the laboratory is interfaced to our Paragon high-performance computer for evaluation of advanced algorithm parameters. A multistatic active sonar modeling capability using the range-dependent acoustic model and the acoustic warfare simulator is included.

Cryptologic Systems Land-Based Test Facility

The Cryptologic Systems Land-Based Test Facility supports prototyping, integration, validation, and testing of tactical cryptologic and information warfare exploitation systems.

Intelligence System Advanced Development Laboratory

The Intelligence System Advanced Development Laboratory offers radio frequency interference-shielded, vault-level security and capability to receive and process data from various sources through online communications.

Microwave and Millimeter-Wave Antenna Range Complex

The Microwave and Millimeter-Wave Antenna Range Complex supports development of surveillance antennas for numerous operational applications.

Processing and Data Exploitation Center

The Processing and Data Exploitation Center is an in-house laboratory facility to conduct data fusion and information processing research for the exploitation of national systems' products for national, unified, and specified command, and joint service and tactical applications.

Real-Time Embedded High-Performance Computing Facility

The Real-Time Embedded High-Performance Computing Facility (RTEHPCF) provides high-performance, parallel computing and visualization resources in a secure environment, with connectivity to other secure locations throughout SSC San Diego and to external locations by use of end-to-end encryption. The primary computational component, a 336-node Intel Paragon, provides up to

High-Performance Computing and Networking

—SOLVING GRAND-CHALLENGE PROBLEMS
—ENHANCING GLOBAL CONNECTIVITY

SSC San Diego is a leader in Department of Defense (DoD) high-performance computing and networking (HPCN). The most recent addition to this capability is an upgrade to our high-bandwidth asynchronous transfer mode (ATM) campus network system linking SSC San Diego and other DoD scientists and engineers with our Intel Paragon and Hewlett-Packard/Convex Exemplar scalable, parallel computing systems. These two systems and ATM links provide DoD employees with both classified and unclassified HPCN environments, enabling the solution of grand-challenge problems in SSC San Diego and other DoD mission areas. Fiber-optic links supporting fiber-optic distributed data interface/ATM/Synchronous Optical Network connections between command-wide facilities are provided to enhance and enable global connectivity for state-of-the-art advances in HPCN and information integration.

33-GFLOPS processing capability with 13.8-GBytes memory, 128-GBytes storage, and 2.3 TBytes of robotically controlled, high-speed tape storage. The RTEHPCF supports state-of-the art applications of parallel computing and visualization to naval and Department of Defense problems and systems, with an emphasis on sensor processing (e.g., sonar, infrared, and synthetic aperture radar).

Surveillance Test and Integration Center

The Surveillance Test and Integration Center (STIC) is a radio frequency interference-shielded vault that can receive and process data from various sources through online communications. STIC supports the Integrated Undersea Surveillance System; Relocatable Over-the-Horizon Radar; Fixed Distributed System; Surveillance Direction System Battle Group Passive Horizon Extension System; intelligence, surveillance, and reconnaissance (an overarching collection of sensor, processing, fusion, display, and dissemination systems); and other tactical or communication efforts that support joint warfare efforts and the C4ISR warfighter. STIC provides a test bed for the support of software development,

integration, developmental verification and validation testing, life-cycle support, data acquisition, and real-time signal processing and display.

Surveillance Radar Development Facility

The Surveillance Radar Development Facility provides a test bed for development of radar waveforms, techniques, and equipment to support inverse synthetic aperture radar, radar cross section measurements, and higher resolution radar developments.

Signals Warfare Integration Facilities and Test Bed

The Signals Warfare Integration Facilities and Test Bed is a secure electromagnetic interference/electromagnetic frequency interference facility that supports the full spectrum of analysis, system development, test and evaluation, simulation, and integration in a multisystem environment supporting signals intelligence, countercommunications, signal security, information warfare, and related cryptologic systems.

Transducer Analysis Computer Laboratory

The Transducer Analysis Computer Laboratory is a facility for evaluation and analysis of transducers, transducer arrays, and acoustic array system performance.

Transducer Evaluation Center

The Transducer Evaluation Center (TRANSDEC) is a controlled-environment, low-ambient-noise, conveniently accessible transducer calibration and underwater acoustic test facility. Operational since June 1964, the facility performs research and development tests, preproduction and production evaluation, and acceptance testing of underwater electro-acoustic transducers for the government, Department of Defense contractors, private industry, and allied nations.

TRANSDEC can perform a wide variety of measurements for a complete transducer evaluation, including but not limited to:

- transmitting voltage, current, and power response
- receiving sensitivity
- directivity patterns
- complex impedance and admittance
- noise measurements and harmonic distortion
- target-strength measurements
- phase measurements between two hydrophones or array elements
- insertion loss of sonar windows

The low ambient noise level in the TRANSDEC pool is ideal for investigating the radiated noise of mechanical devices such as underwater motors, pumps, and low-thrust propulsion systems. Although not filtered, the water clarity in the pool is excellent for photographic work and optical experiments.

Tactical Surveillance Laboratory

The Tactical Surveillance Laboratory (TSL) offers a centralized facility for multiservice and national organizations to display and analyze tactical data systems.

The TSL is a multi-user development and demonstration laboratory capable of processing classified information. The TSL operates with multiple tactical receivers and an array of fielded and developmental end-user processor systems. With its broad reception, broadcast, relay, and processing capabilities, the TSL has the flexibility to provide a wide variety of services and functions to the tactical intelligence community.

Dive Locker

SSC San Diego's Dive Locker is responsible for all diving and diving-related operations in support of SSC San Diego projects. There are

Distributed Test Beds

—SUPPORTING INTEGRATED TESTING

C4ISR systems must link U.S. ships, aircraft, submarines, and land sites, and theater, joint, allied, and coalition forces into an information network that supports warfighters in the execution of their assigned mission. The overarching nature of these systems requires test beds that support the integrated testing of multiple configurations involving components on a global scale. Connectivity for these distributed test beds is provided by integrated virtual networks using both military and commercial communications systems.

currently 36 U.S. Navy qualified civilian scuba divers and 10 enlisted military divers. Facilities are located at SSC San Diego and San Clemente Island. Examples of dive support include planning and conducting at-sea testing, organizing logistics for deployments or remote site testing, remotely operated vehicle operations, underwater facility inspection and repair, Arctic/Ice Camp planning and operations, outboard engine repair and operations, and shipboard interface and operations.

San Clemente Island

Located 80 miles off the coast from San Diego, San Clemente Island provides a physically remote multi-faceted ground, air, and sea test site suitable for a variety of projects. SSC San Diego is one of several tenant commands that operate test facilities at San Clemente Island, and has coordinated the conduct of a variety of test programs over the last 30 years, including Tomahawk, Joint Stand-off Weapon, and Navy Tactical Missile System missiles, SeaLab, Deep Submergence Rescue Vehicle, Deep Ocean Recovery Systems, and most recently the UAV/SSN Interoperability Demonstration.

USS *Dolphin*

The USS *Dolphin* is the Navy's only operational diesel–electric, deep-diving research and development submarine. *Dolphin* provides a cost-effective platform for both scientific research and test and evaluation programs. Working with Naval Sea Systems Command PMS 395 and Submarine Development Squadron 5, SSC San Diego provides homeport to the submarine, which can be modified internally or externally to allow installation of specialized equipment. *Dolphin* can also function as a threat diesel–electric or target vehicle for the evaluation of emerging surveillance or anti-submarine warfare technologies.

Visualization Image Processing Virtual Environment

The Visualization Image Processing Virtual Environment (VIPER) Laboratory is a facility for research and development studies in scientific visualization, interactive image processing, and advanced virtual environments.

VIPER's most prominent feature is the FlexCAVE, a surround-screen, rear-projection, 10- by 10-foot immersive virtual environment that can be operated in either a 3- to 5-person room (U-shaped) configuration or in an up to 25-person, partial immersion theater configuration. The FlexCAVE is driven by a state-of-the-art graphics computer.

Immersion is accomplished via stereographic imagery with 6-degree-of-freedom tracking for up to 12 people. The lab can operate at a wide range of information classification levels via swappable 64-GB disk systems. Video input/output up to digital Betacam quality can be texture-mapped directly on 3-D objects for high-fidelity virtual environments.

Navigation

GPS Central Engineering Activity

The Global Positioning System (GPS) Central Engineering Activity (CEA) was relocated to SSC San Diego in June 1997. The GPS User Equipment CEA has been the Navy's lead laboratory for developing GPS receivers. The CEA was established in 1980 in Warminster, PA. Base Closure and Realignment Commission action in 1995 (BRAC '95) directed relocation of the Warminster Detachment to San Diego. The new laboratory is a unique state-of-the-art facility, providing GPS User Equipment with a development, integration, test, and evaluation environment. Through real-time simulation of both GPS satellite signals and host-vehicle communications, the facility exercises GPS User Equipment hardware and software dynamically under precise laboratory conditions. Environments can be exactly replicated as many times as needed.

Navigation Sensor System Interface Development Laboratory

The Navigation Sensor System Interface (NAVSSI) Development Laboratory provides a facility, replete with navigation sensors identical to those found on U.S. Navy ships, for the development and test of NAVSSI software before introduction to the Fleet. It also serves to provide hands-on training and documentation validation. In addition, previous hardware and software versions of the NAVSSI system are maintained in order to aid in the troubleshooting of any problems identified in the Fleet.

NAVSSI Hardware Development Laboratory

The NAVSSI Hardware Development Laboratory provides an area in which new concepts for NAVSSI hardware can be tested and engineering development models can be

built. The laboratory provides engineering support, including configuration management, logistics, and technical support.

OSPSS System Integration Laboratory

The Ocean Survey Program Survey System (OSPSS) System Integration Laboratory (SIL) contains an integrated navigation system, sonar sensor and processing systems, equipment prototypes, and simulators that replicate existing shipboard systems. The SIL supports the development and test of hardware, software, and signal processing algorithms to meet Ocean Survey Program requirements. The SIL also provides the in-house capability to SSC San Diego engineers and scientists to reproduce shipboard problems and provide rapid response and solutions to these problems.

Fleet Support and In-Service Engineering

AN/FRT ISEA Laboratory

The AN/FRT In-Service Engineering Agent (ISEA) Laboratory supports AN/FRT Series communications transmitters and provides capabilities for development of engineering change proposals, investigation of transmitter design problems, and simulation of fleet transmitter problems. It also supports life-cycle engineering for Navy high-frequency transmitters.

CARIBROC Processing and Display System Laboratory

The Caribbean Regional Operations Center (CARIBROC) Processing and Display System Laboratory provides testing, evaluation, life-cycle support capability, and integrated logistics support functions.

The Communications/TEMPEST Laboratory

The Communications/TEMPEST (Transient Electromagnetic Pulse Emanations Standard) Laboratory provides a capability for instrumented and visual equipment survey, emanations analysis, and testing, evaluation, and pre-installation of communications equipment wiring.

The Cryptographic Repair Facility

The U.S. Navy's primary Cryptographic Repair Facility provides maintenance, repair, and modification of cryptographic and communications security equipment, and interfaces with Navy, Army, and Air Force in matters relating to cryptographic automatic test equipment.

In-Service Engineering Agent/ Pre-Installation Test and Check-Out

The In-Service Engineering Agent and Pre-Installation Test and Check-Out facilities provide engineering and technical services for integration and installation of 2-kHz to 45-GHz radio frequency communications systems, including system design, material control, system integration/installation, and system modifications. Other services are provided in support of high-frequency, very high-frequency, and ultra high-frequency line-of sight; ultra high-frequency, super high-frequency, and extremely high-frequency satellite communications; and commercial satellite communications systems. Services are

provided to U.S. Navy and Coast Guard ships, submarines, aircraft, and shore activities, as well as foreign military sales customers.

Joint Integrated Voice Communications Facility

The Joint Integrated Communications Facility serves as an integration and test facility for legacy and emergent C4I in-service engineering agent maintained systems. Included are full-spectrum radio frequency assets spanning very low-frequency to extremely high-frequency, along with emergent systems and communications infrastructure upgrade programs such as the Automated Digital Network System and Defense Message System. The facility also is used for the pre-installation, test, and check-out of selected equipment, especially those complex items requiring total integration assets to effect initial set-up parameters such as asynchronous transfer mode routers and Windows NT workstations.

Integrated Voice Communications System

The Integrated Voice Communications System Life-Cycle Support Facility, initially installed in 1974 on board USS *Tarawa* (LHA 1), has since been expanded to cover a variety of shipboard integrated communications systems and equipment. Currently, the facility includes labs supporting the AN/STC-1 and AN/STC-2(V) systems, and the AN/WTC-3(V) Dimension 2000, Definity 75, and Mitel SX2000 dial telephone systems. The lab suite supports training, hardware/software maintenance and configuration control, and continued system application engineering. Also included is the Radio Frequency Screen Room, which supports calibration and repair of hand-held radios used in wireless communications systems.

LINK–16 ISEA Laboratory

The Link–16 In-Service Engineering Agent (ISEA) Laboratory has a fully operational Link–16 system and extensive test equipment, providing total life-cycle support to the Link–16 program. Current capabilities include fleet technical support, software development/testing, training, production engineering, and system installation support.

Engineering Software Development Laboratory

The Engineering Software Development Laboratory provides capabilities for Test Program Set development and maintenance to support organic depot repair capabilities for SPAWAR, Naval Inventory Control Point, and Naval Sea Systems Command, and includes state-of-the-art Consolidated Automated Support System, VAX, and LASAR systems.

Intelligent Management Application System Laboratory

The Intelligent Management Application System (IMAS) is an architecture that combines leading commercial software and innovative programming to perform any desired business application through the World Wide Web. The IMAS laboratory provides capabilities for tailoring commercial off-the-shelf software to individual unique missions, automating individual business rules and processes, bringing all business users into the same working environment, and transitioning the business processes to a "truly" paperless environment.

RADIAC Calibration Laboratory

The RADIAC (Radioactivity Detection, Indication, and Computation) Calibration Laboratory provides capabilities for testing, calibration, and repair of distributed radiation detection equipment for the U.S. Navy.

Test Engineering and Restoration Depot

The Depot offers a wide range of capabilities to support shipboard and land-based communication systems test, repair, and restoration, including:

- AUTOCAD
- ESM (Electronic Surveillance Measures) Laboratory
- Teletype Laboratory
- UHF/VHF Laboratory
- NAVMACS (Naval Modular Automated Communications System) Laboratory
- Manufacturing Laboratory
- MATCALS (Marine Air Traffic Control and Landing System) Laboratory
- HF Laboratory
- EHF Laboratory
- AN/URN-25 Laboratory
- IFF (Identification Friend or Foe) Laboratory
- Calibration Laboratory
- Module Repair Laboratory
- Antenna Laboratory

Engineering Services Laboratory

The Engineering Services Laboratory provides facilities to perform environmental testing under shipboard shock, vibration, and climatic conditions, and capabilities to perform structural materials testing, analysis, and corrosion engineering. The Engineering Drawing Management Office provides the database and software tools for the Center's corporate engineering drawing, tracking, and management requirements in a Continuous Acquisition and Life-Cycle Support (CALS)-compliant integrated data environment.

Meteorological and Oceanographic System Laboratory

The Meteorological and Oceanographic (METOC) System Laboratory is a state-of-the-art systems integration laboratory for Navy and Marine Corps METOC equipment, including line data sources.

SURTASS Support

SPAWAR Systems Activity Pacific provides technical and logistical support for the Surveillance Towed Array Sensor System (SURTASS) ships and facilities. SURTASS is a mobile, passive undersea surveillance system; the system acquires data with an acoustic sensor array towed by a dedicated Auxiliary General Ocean Surveillance Ship (T-AGOS). The Integrated Undersea Surveillance System Operations Support Detachment at SPAWAR Systems Activity Pacific in Hawaii provides intermediate maintenance, dockside technical assistance, configuration management, fleet engineering, supply support, and fleet training. Two other commands involved in the SURTASS operations are tenants in Bldg. 992 in Hawaii: Naval Ocean Processing Facility Whidbey Island and Military Sealift Command.

Tactical Systems Support Complex

The Tactical Systems Support Complex supports engineering and technical services, configuration management, software maintenance, and repair of electronic surveillance measures systems. The facility meets rigid information classification requirements.

Ocean Sciences

Ocean Sciences Laboratory

The Ocean Sciences Laboratory provides special facilities for work in marine biology and toxicology, environmental chemistry research, analytical instrumentation development, marine environmental quality assessment and monitoring, environmental biotechnology, radiation sensor development, stochastic resonance, biomedical research, lasers, and microelectronics.

Marine Mammals

Bioscience Facility

The Bioscience Facility provides facilities for acoustical and physiological research, training, and handling of marine animals to perform naval tasks in the open ocean.

Microelectronics

Integrated Circuit and Fabrication Facility

SSC San Diego operates a state-of-the-art integrated circuit facility, generally regarded as a world leader in development of thin-film silicon-on-insulator technology (for radiation hardening). The laboratory has provided major support to the submarine-launched Trident missile program. The laboratory emphasizes research and development, but can span the full range from early materials and device research to development of manufacturable integrated circuit fabrication processes, devices, and circuits that can be transferred to industry.

Accomplishments

The following accomplishments highlight successes across our broad range of work. Most of the accomplishments listed occurred in FY 97; however, to make this document as current as possible and to acknowledge critical successes, some FY 98 accomplishments are included (noted in their descriptions). Accomplishments are grouped by SSC San Diego major areas of effort.

C4ISR

Joint Warrior Interoperability Demonstration 1997

SSC San Diego participated in the Joint Warrior Interoperability Demonstration 1997 (JWID '97), the eighth in a series of demonstrations sponsored by the joint staff. The JWID theme of "Unity of Purpose" describes the demonstration of existing, new, and evolving technologies and methods designed to address real C4ISR issues in a joint and coalition environment. SSC San Diego's contributions to JWID '97 included the following:

- SSC San Diego demonstrated the 3-D Volumetric Display, showing how Link–16 positional data could be spatially displayed to increase situational awareness for the warfighter.
- A first for JWID was the involvement of submarines. The USS *Atlanta* (SSN 712) showcased 12 demonstrations geared to demonstrate technological solutions to interoperability issues between the submarine and the joint or coalition task force commander. SSC San Diego's involvement in the onboard demonstrations of Common Operational Modeling, Planning, and Simulation Strategy, Joint Maritime Communications Strategy, Integrated Situational Awareness, and Sensor-to-Shooter were key to illustrating these solutions.
- SSC San Diego provided valuable support to the JWID Multi-National Task Group. The Multi-National Task Group was a notional coalition task force that demonstrated enhanced coalition information exchange and improved C3 effectiveness and interoperability using ACP-123/X.400 (Allied Communications Publication) messaging between maritime forces from Australia, New Zealand, Canada, the United Kingdom, and the United States. This demonstration included evaluation of multi-cast messaging and message receipt during emission control.

- Specific demonstrations with significant SSC San Diego involvement included: Modeling and Simulation to C4I in the Defense Information Infrastructure Common Operating Environment warfighting environment; Situational Awareness Beacon with Reply; Joint Maritime Communications Strategy Infrastructure; and Integrated Situational Awareness.
- The Pilot Maritime Battle Center (now the C4ISR Systems Integration Environment) provided support to the San Diego secondary sites and demonstrations. See "Large-Scale Integration Demonstrations" below.

Advanced Combat Direction System (ACDS) Block 0

ACDS Block 0 Level 10 has been successfully installed in most CV/CVN (carriers) and LHD (multipurpose amphibious assault) class ships and in two LHA (general-purpose amphibious assault) class ships. Block 0 Level 10 is also installed in the Atlantic Fleet Weapons Training Facility, Puerto Rico; in the Pacific Missile Test Center, Pt. Mugu; and in the Pacific Missile Range Facility, HI.

ACDS Command Table

SSC San Diego continues to provide systems engineering improvements to the ACDS Command Table. The ACDS Command Table offers several new capabilities, including modular design for ease in adapting to different configurations; embedded controls and displays to allow full view of the large-screen displays and color monitors; and a safe at each side wing for storage of classified watch instructions and documentation.

ACDS Peripheral Support Group

The ACDS Peripheral Support Group (PSG) system completed evaluation testing and achieved initial operating capability as the shore-based and shipborne replacement for many of the Navy's legacy peripheral systems. The PSG consists of two commercial off-the-shelf (COTS) hardware units, a peripheral support unit, and a peripheral control station. It uses non-developmental item processor hardware, COTS operating systems, and utility software, and is intended to replace five Navy legacy electromechanical peripherals with small microprocessor-based, general-purpose hardware. It is relatively lightweight, reliable, and logistically supportable. The PSG uses AN/UYQ-70 hardware and software elements and incorporates UNIX-based, real-time operating system and commercial standard versa-module EuroCard architecture.

AN/SLQ-20B

The AN/SLQ-20B was approved to proceed to production by the Naval Air Systems Command on 27 February 1997. SSC San Diego is authorized to award the production contract for AN/SLQ-20B equipment for Aegis destroyers. AN/SLQ-20B was developed and tested by SSC San Diego. Operational evaluation was completed on board USS *John Paul Jones* (DDG 53) during October and November 1996. AN/SLQ-20B was determined to be operationally effective and suitable in January 1997.

Command and Control Advanced Research Network

Command and Control Advanced Research Network assets and experience were used to link multiple SSC San Diego sites and to demonstrate SSC San Diego programs, highlighted by the Command Center of the Future, to VIPs at a central site. The scenario featured a warfighter operating in a collaborative environment supported by

Large-Scale Integration Demonstrations

Recent large-scale integration demonstrations, coordinated all or in part by the C4ISR Systems Integration Environment (SIE), have highlighted two key concepts: the coordination of integration assets throughout SPAWAR and the two-hub, lab-coordination concept.

Pilot MBC Phase 1 (JWID '97) Demonstration. The Pilot Maritime Battle Center (now the C4ISR SIE) provided support to the San Diego secondary sites and demonstrations. JWID '97 provided the maritime community the opportunity to demonstrate unity of purpose and the coordination of integration assets through the employment of the SIE . The C4ISR SIE capitalized on JWID '97 as an opportunity to formally step through and evaluate the key processes associated with collaborative engineering and technology insertion in an integrated laboratory environment.

C4ISR SIE Two-Hub Demonstration. Concurrent with a ribbon-cutting ceremony at SSC Charleston on 6 January 1998 for its new C4ISR Engineering Center, SPAWAR successfully showcased its two-hub concept of lab coordination . Several labs from San Diego and Charleston were involved but were interfaced through one central hub at each site. The SSC Charleston location serves as the East Coast Hub. Dedicated circuits connect SSC Charleston C4ISR SIE with the primary West Coast Hub at SSC San Diego. The two hubs significantly expand the C4ISR SIE's capabilities—and greatly enhance its ability to provide integrated C4ISR systems to the Fleet.

Two major C4ISR SIE objectives were demonstrated: (1) a collaborative engineering environment, supporting technology insertion/assimilation, architecture development, and system of systems integration and test, and (2) a reconfigurable environment created from existing SPAWAR labs.

full-motion video teleconferencing over the SSC San Diego unclassified asynchronous transfer mode backbone.

Contingency Theater Automated Planning System 5.2

SSC San Diego coordinated a joint acceptance test for the Contingency Theater Automated Planning System Version 5.2 (CTAPS 5.2) with the Air Force's 605 Test Squadron. Currently, CTAPS Version 5.1.3 is fielded worldwide to all the services. The proposed upgrade to CTAPS 5.2 is a major stepping stone for the Navy as it is the first version to run on a Navy tactically advanced computer platform. Once accepted, the CTAPS 5.2 system will be fielded worldwide. CTAPS was designed by the Air Force as an elaborate theater-level mission planning and execution system. It comprises applications and databases used to keep track of air assets and targets within a given region.

SSC San Diego is the single software support agency for CTAPS in the Navy and performs configuration management functions on all released software and documentation versions. For the past 5 years, SSC San Diego has supported the Navy by designing, testing, and fielding CTAPS systems for use in the Fleet.

Cryptologic Unified Build Version 2.2.3

The SSC San Diego Cryptologic Unified Build (CUB) team successfully completed testing of CUB Version 2.2.3 in preparation for release to the Fleet. CUB is the common software for cryptologic systems.

Global Command and Control System–Maritime (GCCS–M) Afloat and Ashore

The GCCS–M Afloat and Ashore systems successfully completed operational evaluation in March 1998. Commander, Operational Test and Evaluation Force (COMOPTEVFOR) conducted the test at ten sites simultaneously; it was the largest and most complicated command, control, communications, computers, and intelligence (C4I) test ever conducted. COMOPTEVFOR found the systems to be operationally effective and operationally suitable. Approval for full fleet release was recommended.

Tandem Thrust '97

SSC San Diego provided support to the medical component of the combined U.S./Australian military training exercise called Tandem Thrust '97. The exercise involved more than 28,000 military personnel, 40 ships, and 250 aircraft.

SSC San Diego developed, fielded, and supported software for the C7F Surgeon. The software was designed to enter and track patients within the theater, record the medical condition of those patients, and track the operational status of the various medical treatment facilities involved in the exercise. The information technology provided by SSC San Diego proved to be of great value to the success of Tandem Thrust. The technology demonstrated that a minimum footprint, low administrative cost, user friendly, and command-responsive system can be achieved.

SPAWAR O5L Logistic and Maintenance Support

SSC San Diego became firmly estabished as the Working Integrated Process Team (WIPT) co-leader for Acquisition Logistics Support. The Center led development and issuing of the C4ISR and Information Technology for the 21st century (IT-21) Supportability Plans, developed processes to identify how WIPT members and organizations were going to operate, assisted in development and marketing of the Intelligence Management Application Server/Logistics Interactive Distributive Database System architecture, and established a major support "link" between SPAWAR O5L and O5F to improve support for system installation activities. The Center also established the Maritime Battle Center homepage, improved the 05L homepage, and initiated development of the 05L Training homepage. In addition, SSC San Diego was assigned as SPAWAR IT-21 training coordinator and tasked to integrate training requirements with the installation activities for C4ISR/IT systems/equipment during the battle group/amphibious ready group interdeployment training cycle. SSC San Diego has become a "Center of Excellence" for C4ISR training, planning, and management and has also become the C4ISR training integrator, consolidating and merging all C4ISR training needs for each battle group.

Transportable 3-D Display

SSC San Diego, with its industrial partners (Neos Technologies, Inc., RGB Technology, Inc.) achieved a major milestone with the successful installation and demonstration of a Transportable 3-D Volumetric Display System on board the USS *John C. Stennis* (CVN 74) at Norfolk, VA, while participating in the

COMPASS—Golden Nugget Award for JWID '97

The Common Operational Modeling, Planning, and Simulation Strategy (COMPASS) project received the "Golden Nugget" award for JWID '97 demonstration, JW-023, "Modeling and Simulation (M&S) to Command, Control, Communications, Computers and Intelligence (C4I) in the Defense Information Infrastructure Common Operating Environment."

The Pentagon uses the annual JWID series to uncover "golden nugget" technology that can quickly make the jump from concept or demonstration to use by active duty forces. Four JWID demonstrations, including COMPASS JW-023, were awarded a "Golden Nugget." The joint staff has now tasked the JWID '97 Joint Project Office to expedite plans for operational fielding of COMPASS services.

See additional COMPASS accomplishments described in this section.

Department of Defense's 1997 Joint Warrior Interoperability Demonstration (JWID '97). The 3-D Display was interfaced to the common operational picture data network and evaluated with live tactical data. The following comments were received after demonstrations to Department of Defense and industry representatives:

- From CAPT Dennis Murphy (Director of JWID '97) to SSC San Diego Commanding Officer, CAPT Hal Williams: "3-D Volumetric Display a success at four-star level in JWID '97. ADM Geham (Vice CNO) was particularly impressed by the potential of this technology."
- From RADM Stephen Johnson to RADM George Wagner (Commander of SPAWAR). Comments on Navy's 3-D Display at JWID '97 related to the *Vincennes* shoot-down of the Iranian Air Bus: "If the air picture had been displayed on a 3-D Display with the civilian traffic lanes marked on the display, they probably would never have considered it a threat and would probably never have fired. Similarly, if the *Stark* had had a 3-D display showing the inbound airplanes flying an attack profile, they might not have taken a hit."

Advanced Enclosed Mast/Sensor System

The Advanced Enclosed Mast/Sensor (AEM/S) System was installed on the USS *Radford* (DD 968), replacing the aft mast with an advanced composite enclosing structure. In preliminary tests, AEM/S demonstrated the capability to reduce or eliminate antenna blockage and false target echo problems associated with current metallic masts. It also shows potential for reducing mast preservation and maintenance by enclosing antennas inside the mast panel. The AEM/S is a key enabling technology for next-generation sensors and communications antennas. It will reduce life-cycle costs and pave the way for improvements to ship topside arrangement and design, and allow for incorporation of embedded sensor antennas and multifunction planar arrays.

COMPASS/JTFEX 97-1

COMPASS team members were recognized for outstanding support by official message 232350Z APR 97, PAC JTFEX 97-1 BRAVO ZULU, noting: "The exceptional support provided in planning the TBMD [theater ballistic missile defense] exercise scenario, equipment procurement, installation, and testing in the training and guidance to the JTF [Joint Task Force] and JFACC [Joint Forces Air Component Commander] staffs in the areas of modeling, simulation (M/S) and distributed collaborative planning (DCP) enabled the successful accomplishment of all TBMD exercise objectives."

COMPASS team members installed COMPASS-capable systems at six warfighter sites participating in Joint Task Force Exercise (JTFEX) 97-1 (Pacific): (1) USS *Coronado* (ACF 11); (2) USS *Constellation* (CV 64); (3) USS *Boxer* (LHD 4); (4) MCAS Yuma, AZ; (5) NAS Fallon, NV; and (6) Ft. Bliss, TX. Also, COMPASS-capable systems were used from four modeling and simulation sites: (1) SSC San Diego's M&S Operations Support Cell; (2) Space Warfare Center, Falcon, CO; (3) U.S. Army Chemical and Biological Defense Command, Aberdeen, MD; and (4) Defense Special Weapons Agency, Alexandria, VA. Team members supported these sites throughout the JTFEX 97-1 exercise.

COMPASS/Kernel Blitz '97 Exercise

The COMPASS team provided 2 weeks of support to warfighters on USS *Coronado* (AGF 11) and USS *Tarawa* (LHA 1) during Kernel Blitz '97 training exercise. The SSC San Diego Modeling and Simulation Operations Support Cell served as a focal point for providing support to these sites in their reachback to other modeling and simulation nodes and in briefbacks to warfighters. *Tarawa* naval message (022045Z JUL 97) to COMPHIBGRU THREE, stated: " . . . COMPASS provides a previously unavailable C4I capability. COMPASS was used extensively and effectively for coordination of aircraft mission planning and information transfer. Extremely reliable. Marine personnel requested its future availability in CIC [Combat Information Center] with more numerous workstations."

Reconfigurable Antennas

SSC San Diego developed a new metal oxide semiconductor gate process that significantly reduces the parasitic coupling between individual antenna elements. This reduced coupling allows the antenna array to be used at higher frequencies without prohibitive losses. Operation above X-band is now possible.

Radio Propagation Over Terrain

SSC San Diego has developed a new radio propagation assessment system that accounts for the combined effects of atmospheric ducting

and terrain on radar and radio coverage. The Radio Propagation Over Terrain (RPOT) program combines the latest radio propagation models, atmospheric data from many sources, and the Digital Terrain Elevation Data maintained by the National Imagery and Mapping Agency.

RPOT has been distributed Fleet-wide and is also being used by the other services. RPOT is now serving as the basis for the next-generation propagation assessment system known as the Advanced Refractive Effects Prediction System, which will replace the Integrated Refractive Effects Prediction System developed in the 1970s.

Satellite TADIL J

While in transit from Hawaii to West Coast homeports 7–12 November 1996, USS *Carl Vinson* (CVN 70) Task Group (TG) demonstrated reliable two-way real-time satellite tactical digital information link (TADIL) connectivity between S-TADIL J-equipped platforms over extended distances. Commander, Cruiser-Destroyer Group Three message P021610Z JAN 97 stated in part: "The C2P [Command and Control Processor] combined with S-TADIL J effectively eliminates medium- and long-range connectivity holes, gaps, and propagation limits of traditional TADILs. This TG was provided with an unprecedented degree of TADIL connectivity resulting in a consistent tactical picture throughout the Force, greatly enhancing situational awareness. Continuous and robust link connectivity greatly decreased workload associated with tactical situation display management and maintenance on all platforms. Recommend S-TADIL J capability be added to operational C2P software immediately and provided to all TGs."

Exercise Initialization

SSC San Diego and industry partner ATI created a 50,000-vehicle simulation scenario in less than 72 hours using the SSC San Diego-developed Exercise Initialization (ExInit) software tool. ExInit has been designed to permit the rapid generation of extremely large, doctrinally plausible, simulation scenario files with minimal user input. ExInit runs on a low-cost PC under the Windows NT operating system and can import real-world tactical doctrine and force-structure information to minimize the operator's training requirements.

ICESHELF-97

Iceshelf-97 was the 1997 field experiment for Project Spinnaker, a joint U.S./Canada effort to place a large-aperture acoustic monitoring array underneath the arctic ice. The technology developed for this project has included:

- Longest-known autonomous undersea vehicle self-navigated run to lay fiber-optic cable (160 km)
- World's longest unrepeated fiber-optic link (160 km, designed 210 k)
- First large-aperture Arctic Ocean shore-telemetry array
- Largest Arctic Ocean contiguous acoustic data set gathered
- Low-cost, lightweight, low-power array technology developed (generally applicable)
- (I-97) First demonstrated node replacement on a working array at site
- (I-97) First splice repair of a deployed fiber-optic telemetry cable

Autonomous Sensor Concepts Project

The High-Performance Computing Modernization Program approved funding for the Advanced Virtual Intelligence, Surveillance, and Reconnaissance (AdVISR) project. The effort will focus on the development and demonstration of high-fidelity sensor and communications models within the modular, extensible, reusable, distributed interactive simulation (DIS)-compatible environment of the AdVISR simulation system being developed by the Autonomous Sensor Concepts Project. AdVISR provides a physics-based DIS-compatible capability for evaluation of surveillance sensors, communications, data fusion, and command and control systems. The objective of the project is to demonstrate the value of high-performance computing to meet Navy advanced virtual, real-time simulation needs.

ISTEF Data Collection

The Innovative Science and Technology Experimentation Facility (ISTEF) successfully provided range safety personnel with real-time laser imagery during the launch of the Space Shuttle (STS-81). ISTEF has been developing a laser-imaging system to provide real-time night imagery of NASA's Cassini launch. Current range assets cannot see the launch vehicle during the critical portion of flight, the first 15 seconds, due to the bright plume. Imagery of the vehicle hardbody during the first 15 seconds would afford a margin of safety by allowing time to destroy the vehicle should problems occur.

Internetted Unattended Ground Sensors

SSC San Diego personnel completed a quick-look analysis for the Defense Advanced Research Projects Agency (DARPA). This was the first look at the performance of DARPA/SSC San Diego's main brassboard internetted unattended ground sensors: the acoustic sensor, the seismic sensor, the magnetic sensor, and the meteorological sensor. Field tests were performed in Yuma, AZ, 21–25 July 1997 with 12 different types of time-critical targets. Further testing will follow algorithm enhancements based on this quick-look analysis.

SmartNet

Commander, Third Fleet message 211250z Feb 97, (Subject: PAC JTFEX [Joint Task Force Exercise] 97-1 NSS [Navy Strategic Studies] BRAVO ZULU) cited SmartNet as follows: "The NSS Team, using SSC San Diego's SmartNet software, successfully demonstrated distributed heterogeneous computing across the SIPRNET [Secret Internet Protocol Network] using different computers at CINCPACFLT [Commander in Chief, Pacific Fleet] and the Maui High-Performance Computing Center. Use of reachback high-performance computing resulted in NSS runs completed in minutes vice hours, enabling increased opportunity for the strike analysis."

Soldier 911

SSC San Diego personnel made important progress in installing and demonstrating the Soldier 911 system in South Korea. Soldier 911 is a geolocation, situational awareness and border alert system installed in U.S. Army UH-60 helicopters flying near the North–South Korean border. The system is used by U.S. Army soldiers on foot patrol near the Serbia–Macedonia border and in the joint security area (JSA) along the North–South Korean border.

The demonstrations in South Korea involved enroute navigation, border warning, and position reportback. Soldier 911 ground-based systems are operational and operating at three remote sites. Two Soldier 911

computers are used by Air Traffic Control to monitor north and south sector traffic. The JSA ground-based Soldier 911 system was installed and is operational. Improved Global Positioning System wiring kits were installed in four 17th Aviation helicopters. Flexible ultra high-frequency antennas were installed on the belly of all Soldier 911 helicopters. Four medical evacuation (MEDEVAC) helicopters were wired for the Soldier 911 system and three MEDEVAC Soldier 911 helicopter consoles are installed and operational.

TACINTEL II+

SSC San Diego's string of TACINTEL (Tactical Intelligence) II+ program successes continued with receipt of the OT (operational test)-IIA test report from Commander Operational Test and Evaluation Force (COMOPTEVFOR). TACINTEL II+ (Build 1) was determined to be both operationally effective and suitable. COMOPTEVFOR recommended fleet introduction to the Chief of Naval Operations. The TACINTEL II+ program provides a simplified, easily upgraded, technologically advanced, secure, and highly flexible special intelligence communications system for supporting Navy operations.

Universal Radar Moving Target Transponder

The Universal Radar Moving Target Transponder (URMTT) successfully demonstrated its ability to transpond realistic radar targets over the air against the 996 (frequency agile) air/surface search radar on the HMS *Westminster*, a United Kingdom frigate. Demonstration was made to representatives from seven North Atlantic Treaty Organization (NATO) countries that are members of the Fleet Operational Readiness Accuracy Check Sites (FORACS) Steering Committee. A hurricane off Cuba provided URMTT with a chance to demonstrate operation under challenging inclement weather conditions. This is a key advantage to URMTT; target drones and actual aircraft for radar targets normally would not operate under these conditions. In addition to the "any time and any weather" advantage, URMTT provides a substantial cost-avoidance advantage over drones and real aircraft.

Project DUNDEE

In FY 97 SSC San Diego participated in Project DUNDEE, a joint program between the Ballistic Missile Defense Organization and the Australian Defence Science and Technology Organisation to investigate the use of high-frequency radar for theater ballistic missile (TBM) defense. We installed a portable high-frequency radar in Western Australia (WA) and successfully detected and tracked four TBMs launched from a site near Broome, WA. Based on the success of Project DUNDEE, the project has continued in FY 98 as DUNDEE II, for which SSC San Diego is the technical execution agent. Observations of TBM launches from White Sands Missile Range will be carried out by the SSC San Diego portable high-frequency radar, and by the Wide Area Radar Facility, an over-the-horizon high-frequency radar located near Los Banos, CA. The results of both DUNDEE programs will be used to assess the application of the high-frequency surface wave radar to TBM defense.

Navigation

Global Positioning System

SSC San Diego completed design and development on the Location of GPS Interferers, an electronic system that locates sources of interference that might be operating within

the GPS frequency spectrum. The initial testing, which will lead to a flight demonstration, was begun. The Center completed laboratory testing and functional configuration audit to begin production of the GPS VME Receiver Card. Also completed was formal qualification testing for the command and control software, with delivery to the platform for flight testing in support of developmental testing.

Navigation Sensor System Interface

The Navigation Sensor System Interface (NAVSSI) system has been developed using an evolutionary acquisition strategy, whereby an initial capability is deployed promptly and then improved over time using software and hardware upgrades. During FY 97, the third major NAVSSI system release (Block 2) successfully completed its operational evaluation aboard the USS *Lincoln* (CVN 72), clearing the way for the deployment of this upgraded capability to the Navy. Work on Block 3, which will bring NAVSSI onto DDG 51 class destroyers, is under development. The use of commercial off-the-shelf hardware and government off-the-shelf software has enabled the Navy to deploy and maintain NAVSSI at a fraction of the cost that would have been associated with a traditional procurement.

Ocean Survey Program Survey System (OSPSS)

The United Kingdom Ocean Survey Vessel/Ocean Survey Program Survey System (UK OSV/OSPSS) was designed, developed, and installed aboard the UK survey vessel, HMS *Scott*. The OSPSS was formally accepted and turned over the UK Ministry of Defence. Completion of this major program milestone marked the conclusion of a vigorous 3-month dockside and at-sea technical evaluation and formal UK OSV/OSPSS acceptance testing conducted by SSC San Diego engineers and scientists. The HMS *Scott*, a new construction vessel, was designed and built specifically to support the SSC San Diego-developed and fully integrated survey system. The OSPSS collects navigation, bathymetry, and gravity data to produce high-accuracy bathymetric and gravimetric charts and other survey products. The HMS *Scott* is now considered the UK's premier deep-ocean survey platform. SSC San Diego is conducting all necessary life-cycle support tasks required to ensure optimum shipboard survey system availability, performance, reliability, and matainability.

Microelectronics

Integrated Circuits

SSC San Diego began technology transfer of an integrated circuit design to Hughes Aircraft Company. The integrated circuit was initially designed for SSC San Diego's ultra-thin silicon-on-sapphire 1.2-micron process and is being redesigned for fabrication at Hughes Newport Beach facility in its SOS3D process. The circuit is a prototype of a non-volatile memory chip using ferroelectric capacitors as the memory elements.

Office of Naval Research Microelectronics Program

SSC San Diego, in cooperation with Lawrence Semiconductor, successfully deposited SiGe directly on sapphire. Transmission electron microscopy, Rutherford backscattering spectrometry, and X-ray analysis performed show single crystal material with 5% Ge content. This is the first known successful attempt to deposit this material on sapphire. This high-mobility semiconductor has future applications in silicon-based microelectronics for C4ISR systems.

Wavelength Division Multiplexing Technology

SSC San Diego and SDL, Inc. have negotiated and signed a Cooperative Research and Development Agreement (CRADA), the "Wavelength Division Multiplexing Technology for U.S. Navy Fiber-optic Telemetry Systems." The objective of this CRADA is to further the development of advanced wavelength division multiplexing components and subsystems for applications to Navy and commercial sector high-bandwidth, fiber-optic-based systems. SDL intends to acquire the necessary SSC San Diego technology, via patent licenses, to commercialize the technology and market the devices. The patents of interest describe methods of producing fused-fiber wavelength division multiplexers with optical channel spacings less than 30 nanometers.

Fleet Support and In-Service Engineering

Coast Guard Support

SPAWAR Systems Activity Pacific provides engineering and communication support and services to the Coast Guard District 14 (Guam and Hawaii). In FY 97, major accomplishments included installing a turnkey digital microwave system that provides communications between Wahiawa and Lualualei, HI, and conducting electronic systems readiness tests on all District 14 Coast Guard cutters. The Activity also continued to provide engineering services for the National Distress System Modernization Project.

Contingency Theater Automated Planning System

SSC San Diego completed Contingency Theater Automated Planning System (CTAPS) expansion/installation, including software load, on board USS *Blue Ridge* (LCC 19). This installation added nine Sun workstations to the six existing CTAPS workstations. A total of 23 drops was provided to support current and future needs. All workstations are tied to a new hub that will be connected to the ship's SHF Secret Internet Protocol Network pipe. SSC San Diego also completed activation of connection into the CTAPS network for Commander, Patrol Wing One/Commander Task Force-72 Headquarters at Kamiseya, Japan. Access to CTAPS will greatly improve CTF-72 capabilities for participation in and response to tactical plan development and execution in support of Seventh Fleet operations.

Cryptographic Repair

The Cryptographic Repair Facility (CRF) analyzed and solved a long-term problem with KG-40 crypto key generators used throughout the Fleet. Requiring no special or additional parts, the fix can be done within 20 minutes. This repair procedure will affect and correct all KG-40 and KG-40A systems in the U.S. Navy and allied forces. In addition, a communications security equipment pool of ready-for-issue assets was established at the CRF, reducing fleet and shore customer turnaround time from several days to immediate exchange.

PMRF Communication Systems

SSC San Diego completed a major communications upgrade at the Pacific Missile Range Facility (PMRF), HI, under the Central Communications Network Upgrade program (CCN-II). PMRF provides major range services to facilitate training, tactics development, and evaluation for air, surface, and subsurface weapons systems for the Pacific Fleet, Department of Defense agencies, and foreign

military joint exercises. PMRF is the world's largest multi-environment range that can support underwater, surface, air, and space operations. The CCN-II program will modernize the communications system at PMRF to meet new demands and support the Fleet.

Ulchi Focus Lens '97

SSC San Diego played a major support role during exercise Ulchi Focus Lens '97 in Korea. SSC San Diego engineers installed and activated 12 circuits end-to-end throughout the Korean peninsula. After all circuits were activated, continued support was provided for the duration of the exercise to assist in network monitoring.

Mobile Detection Assessment Response System

SSC San Diego delivered the Multiple Robotic Host Architecture (MRHA) and coordinated the installation of a Mobile Detection Assessment Response System (MDARS) interior system for early user testing. The MDARS Interior program completed Milestone II and entered engineering manufacturing development (EMD) for the interior robot and control system. SSC San Diego will maintain the MRHA software during EMD and transition it to the system contractor.

SATCOM Foreign Military Sales

Engineering analysis and design support to countries including Japan, France, Germany, and Great Britain enabled installations of upgrades and modifications to 5-kHz systems, some of which represented joint service sup-port endeavors. Design and construction services were provided in support of the French depot repair facility for UHF SATCOM and a separate maintenance station for use on board the French aircraft carrier *Charles De Gaulle*. New Zealand was provided extensive logistics support in its attempt to find a lightweight antenna system for *Canterbury* class ships.

Systems Engineering

SSC San Diego developed a communications architecture for the Hunter Warrior exercise to provide ship-to-disembarked Marine Corps forces communications using standard Navy and Marine Corps equipment strings. SSC San Diego also demonstrated asynchronous transfer mode communications capability over Navy/Marine Corps line-of-sight and satellite communications links.

Automated Digital Network System

SSC San Diego completed installation and system operational verification test for all ships in the *Lincoln* battle group, the first battle group to have the Automated Digital Network System (ADNS) installation completed prior to the technology completion date. SSC San Diego conducted testing of ADNS over 5-kHz on board USS *Shiloh* (CG 67), USS *Valley Forge* (CG 50), USS *Elliot* (DD 967), and USS *Jarrett* (FFG 33), the first time Internet Protocol traffic has been sent over a 5-kHz channel from a U.S. Navy vessel.

Base-Level Information Infrastructure

In support of the Base-Level Information Infrastructure Program for the Defense Information Infrastructure Common Operating Environment, the engineering plans were completed for implementation of Base Area Networks in the Pacific Northwest (six bases) and Pacific Southwest (five bases), which included gathering of infrastructure data for over 200 commands/activities. In

addition, pierside connectivity for the USS *Coronado* (AGF 11) at SUBASE San Diego was designed and installed.

Tactical Environmental Support System

SSC San Diego designed, produced, and fielded the Tactical Environmental Support System (TESS) Next Century Transition (NCT) that replaced existing proprietary UNIX-based hardware and a monolithic software build. TESS NCT underwent and successfully passed follow-on test and evaluation in December 1997 with the following comments: "TESS NCT demonstrated significant increases in processing capability, data storage capacity, and software functionality over the basic TESS system. The capability to access the Secret Internet Protocol Network was a major enhancement. The Windows NT operating environment greatly improved operator ease-of-use and human–machine interface." Praise also came from the Oceanographer of the Navy, RADM Paul Tobin, in a formal naval message stating: " . . . your aggressive timeline moved rapidly from preliminary system design, to prototype deployment, to successful operational evaluation, to fielding. The sustained diligent work of SPAWAR/SSC and developer personnel since February 1997 put powerful new PC-based Information Technology for the 21st century (IT-21) compatible functionality and connectivity directly in the hands of the fleet forecasters."

Link–16 In-Service Engineering Agent

SSC San Diego provided technical assistance and training to the USS *George Washington* (CVN 73) and USS *Nimitz* (CVN 68) battle groups to ensure Link–16 functionality and interoperability while deployed in the Arabian Gulf. As part of the assistance, Joint Tactical Information Distribution System (JTIDS) Network Library (JNL) 28 was developed and hand carried to both battle groups. JNL 28 was created to provide the options required for two battle groups operating on a common Link–16 network.

RADIAC Calibration

SSC San Diego established an equipment repair/calibration workload with SPAWAR foreign military sales to provide RADIAC (radioactivity detection, indication, and computation) units for foreign governments, shipped equipment to Australia, and will be shipping a large quantity to Saudi Arabia. The Center is the first Navy RADIAC lab to provide services to non-U.S. customers and the only RADIAC Calibration Laboratory on the West Coast. Due to workload increases, a new RADIAC laboratory was established at Battery Ashburn South. The new RADIAC facility mission is testing, calibration, and repair of distributed radiation detection equipment for the U.S. Navy.

Marine Mammals

Mine Countermeasures

The Mk 4 and Mk 7 systems participated in Kernel Blitz '97 and Joint Task Force (JTF) EX 97 Fleet Exercises. The Mk 4 MMS is a tethered mine-hunting system and the Mk 7 MMS is a bottom mine-hunting system. SSC San Diego also successfully completed the feasibility demonstration of a new mine countermeasures MMS that will operate in very shallow water.

Marine Mammal Acoustic Tracking System

SSC San Diego personnel completed the final on-site data collection phase of the northern right whale mitigation exercise. In addition to the 13 acoustic sightings made using the

Marine Mammal Acoustic Tracking System, a significant collection of infrared sightings were made in the area by using an AN/KAS-1A infrared detection system.

Independent Research

Broadband Fiber Source Power and Spectrum Dependence on Reflectance and Filter Properties

This Independent Research (IR) project investigated rare-earth doped optical fiber light sources. A goal of the project was to devise novel methods to improve performance. Optical fiber sources are the most promising light source for interferometric fiber-optic gyroscopes (IFOGs). Because of high sensitivity, physical robustness, and potential low cost, IFOGs are a leading candidate for next-generation tactical- and navigation-grade gyroscopes for a wide variety of military and civilian systems.

A key component for IFOGs is the optical source. Requirements for the optical source are high power, wide spectrum, wavelength stability, low cost, and small size. Rare-earth doped optical fiber amplified spontaneous emission (ASE) sources are the most promising technology to achieve these requirements. However, a current limitation of ASE sources is inadequate wavelength stability, particularly as affected by temperature. The instability results primarily from gain competition between emission wavelength peaks, and can be substantially mitigated by implementation of an optical filter in the ASE source. The project successfully demonstrated a simple, potentially low cost, optical filter based on fused fiber coupler technology.

The project was incorporated into an ongoing Defense Advanced Research Projects Agency (DARPA) sponsored Manufacturing Technology (MANTECH) program for IFOGs.

Constant Envelope Modulation Techniques for UHF SATCOM

This IR project investigated modulation techniques resistant to signal distortion caused by non-linear amplifiers and communication channel effects. The project successfully identified and developed novel combinations of pulse shape and code modulation that are highly resistant to the non-linearities occurring in ultra-high-frequency satellite communication (UHF SATCOM) systems, thereby enabling a large increase in data rate capabilities. Project results were incorporated into a program sponsored by SPAWAR to develop standards for medium-data-rate UHF SATCOM systems.

Modulation and waveform standards resulting from this project will also be integrated into a new SPAWAR Digital Modular Radio system as an option in FY 99. In addition, there is great interest in the improved modulation methods by many Navy groups (including participants in the Information Technology for the 21st Century [IT-21] effort) seeking to achieve increased data rates to surface and subsurface combatants via acoustic as well as electromagnetic communication systems.

Faster-than-Real-Time Synthetic Forces Simulation

This IR project investigated software architectures for realistic computer simulation of military forces at very high speed. The goal was to achieve simulation speeds that exceed real-time simulation (i.e., simulation time

equal to physical time). This process is referred to as faster-than real-time simulation (e.g., execution of 2 days of simulation time within a period of several hours.)

The project identified two software architectures and a single software abstraction layer that achieve the desired goal of faster-than-real-time simulation of realistic military forces and equipment. This objective was accomplished at both the electronic circuit level for military equipment and the theater level for military forces. These capabilities have been demonstrated and accepted for transition into fleet programs.

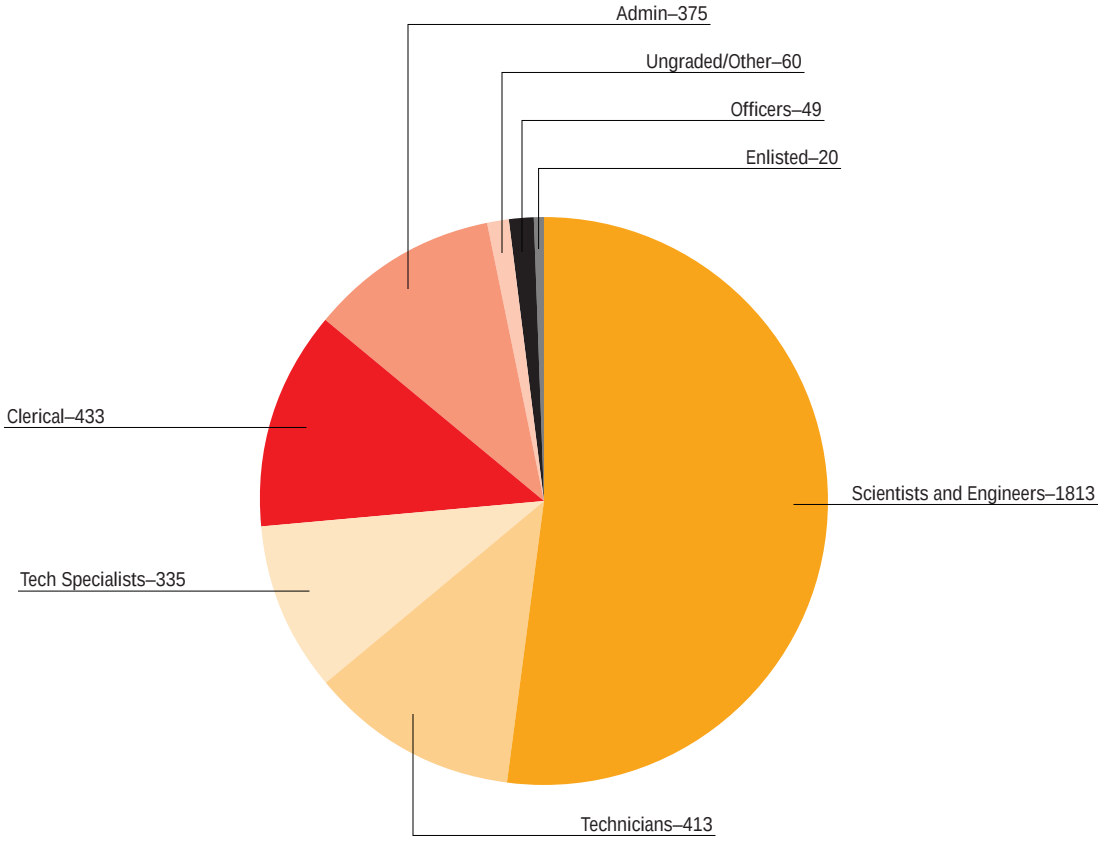
Stochastic Resonance Detectors

This IR project investigated novel signal detection methods in Superconducting Quantum Interference Devices (SQUIDs) based on the phenomenon of stochastic resonance. A principal goal of this effort was to develop SQUID detectors that would be robust in the presence of high levels of background noise.

Although conventional SQUID magnetic detectors are highly sensitive, they have characteristics that severely limit their applications. One limitation is that conventional superconductors require expensive cryogenic cooling apparatus, and a second limitation is that the "slew" rate, or ability to respond to rapidly varying fields, is restricted by the feedback system employed in radio frequency modulated SQUIDs. Both of these limitations can potentially be circumvented by development of novel detection methods that exploit stochastic resonance phenomena. A noise-robust SQUID could use high-temperature superconductors to alleviate the expense of cryogenic cooling. In addition, a noise-robust system could be used outside the shielded environments in which laboratory SQUID detectors are normally employed.

The project successfully developed a SQUID detection scheme that shifts the detection of a low-frequency magnetic signal out of the 1/f noise regime, while maintaining high slew-rate capability. This accomplishment has enabled the project to transition to exploratory commercial development under a Naval Air Systems Command (NAVAIR) sponsored Phase II Small Business Innovation Research (SBIR) program with Quantum Magnetics, Inc.

Personnel,Organization, and Funding

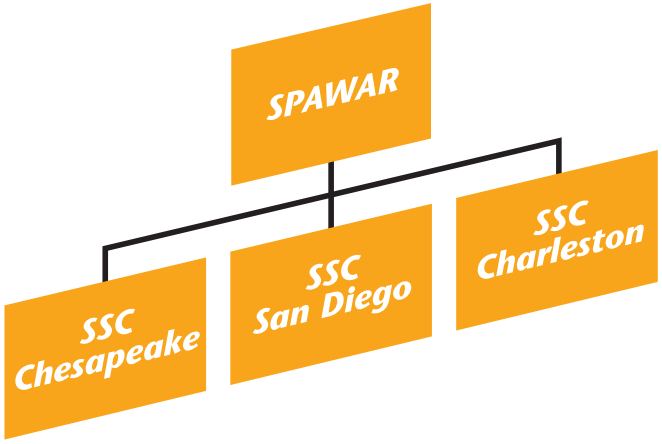


Personnel

People are critical to the successful achievement of our vision. The majority of our personnel are scientists and engineers, with numerous technical contributions to their credit. Many have decades of experience in the Navy acquisition community. Looking toward the future, SSC San Diego continues to actively recruit outstanding computer science, computer engineering, and electronic engineering candidates for our New Professionals program.

The chart shows FY 00 projected end strength.

FY 2000
Total 3498



Space and Naval Warfare Systems Command (SPAWAR)

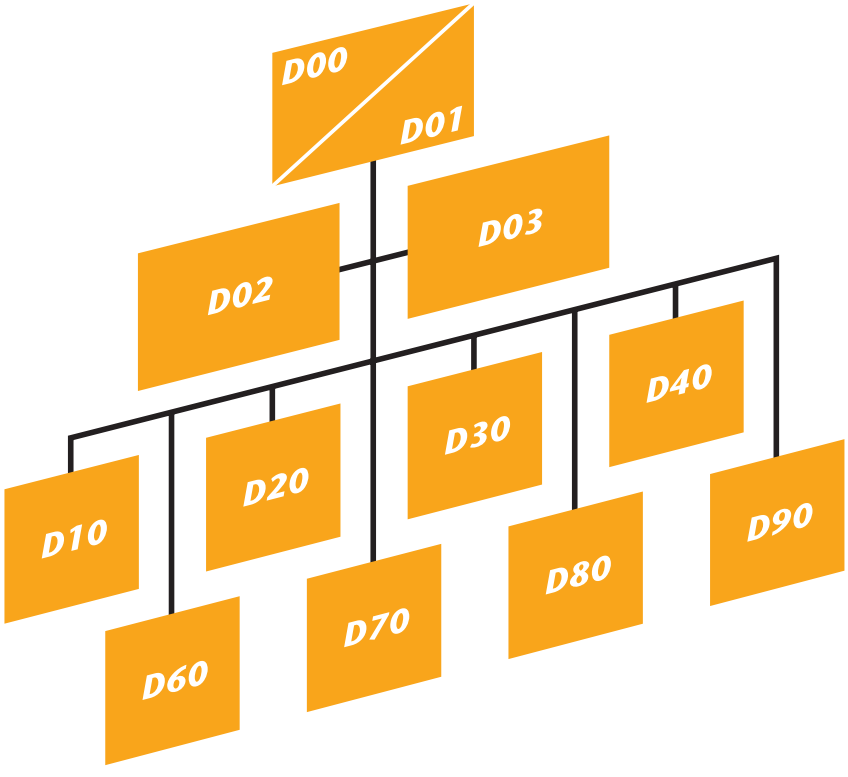
SPAWAR Systems Center Chesapeake

SPAWAR Systems Center San Diego

SPAWAR Systems Center Charleston

Organization

SSC San Diego is one of three systems centers reporting to the Space and Naval Warfare Systems Command (SPAWAR).



D00–Commanding Officer

D01–Executive Director

D02–Deputy Executive Director for Corporate Operations

D03–Executive Officer

D10–Deputy Executive Director Science, Technology, and Engineering

D20–Supply

D30–Navigation and Applied Sciences

D40–Command and Control

D60–Fleet Engineering

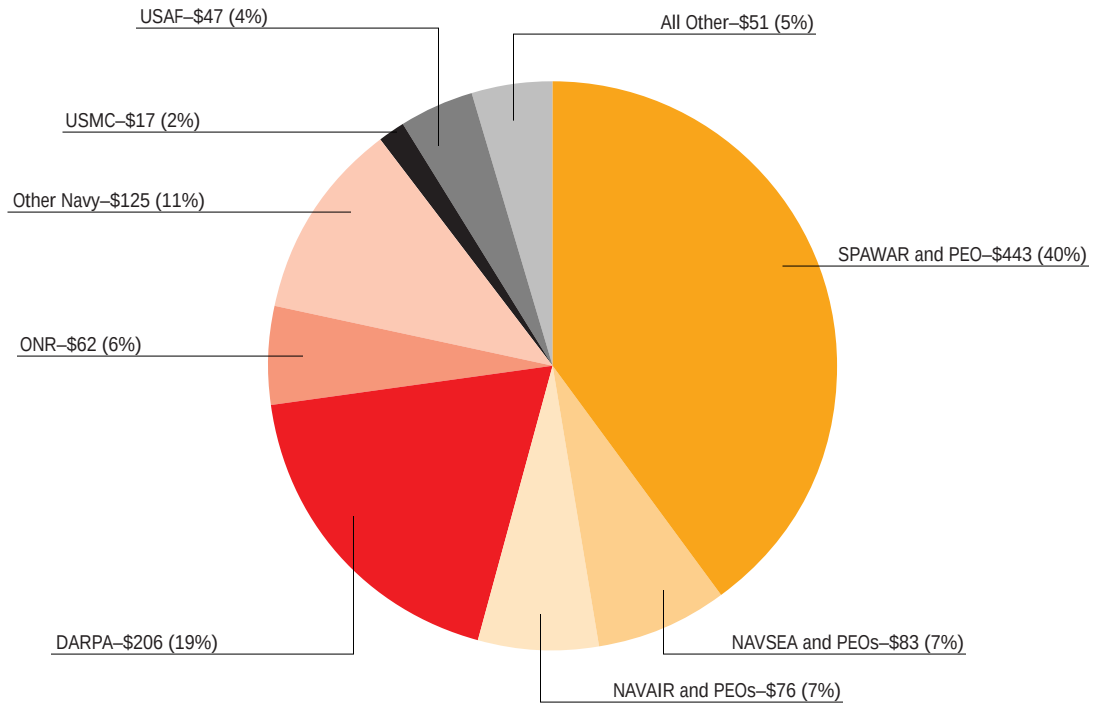
D70–Intelligence, Surveillance, and Reconnaissance

D80–Communication and Information Systems

D90–SPAWAR Systems Activity, Pacific

SSC San Diego Organization

Organization continues to evolve to support our work across the spectrum of C4ISR—cross-organizational teaming facilitates a responsive, flexible workforce.



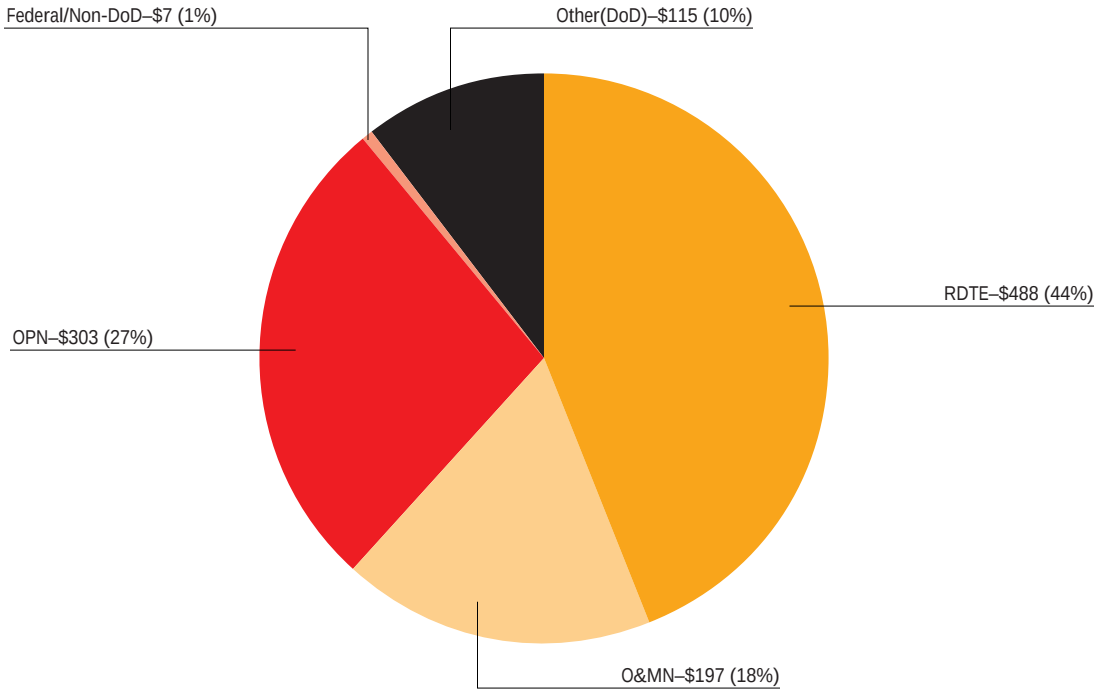
Funding

SSC San Diego Funding by Sponsor

Under the industrial funding concept, unique to Navy acquisition commands, SSC San Diego operates substantially like a private business, with customers—we use the term "resource sponsors"—to whom we provide goods and services in our C4ISR product line.

The chart shows projected funding for FY 00 (in millions).

FY 2000 Total
$1.110 Billion

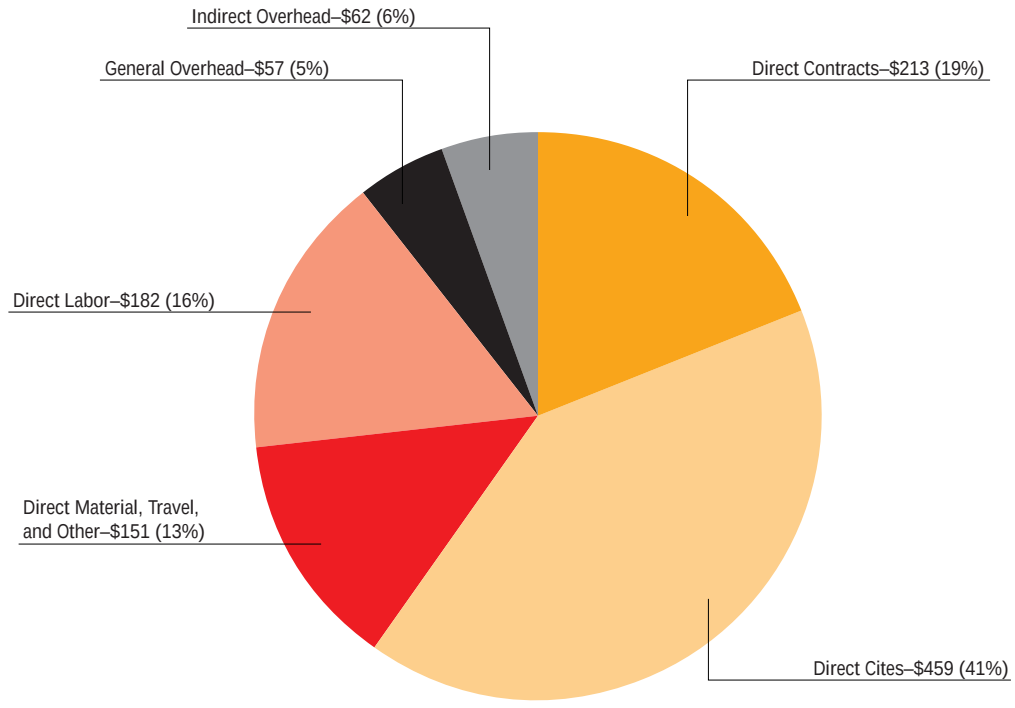


SSC San Diego Funding by Appropriation

Although research and development constitutes about a third of our work, the principal focus of our efforts, distributed throughout the appropriation categories shown on the chart, is systems engineering and integration in support of the Fleet.

The chart shows projected funding for FY 00 (in millions).

FY 2000 Total $1.110 Billion



SSC San Diego Distribution of Costs

We have considerable industrial support for our efforts. A substantial part of our funding goes to our contractor partners. That includes the funding in both the "Direct Contracts" and "Direct Cites" categories.

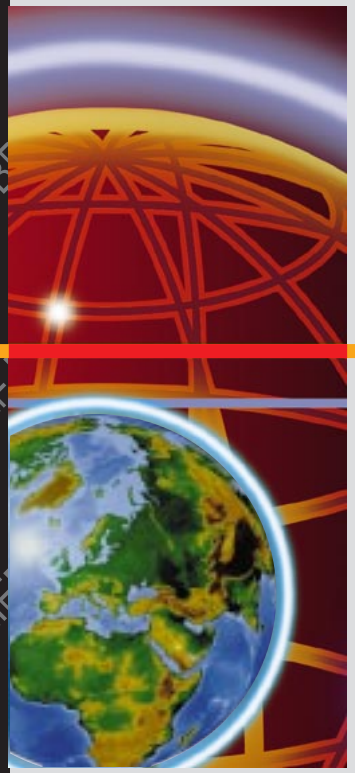
The chart shows projected distribution of costs for FY 00 (in millions).

FY 2000 Total $1.124 Billion

Reviewed and approved by

Ernest L. Valdes, CAPT, USN
Commanding Officer

Space and Naval Warfare Systems Center
San Diego, CA 92152-5001



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San Diego, CA 92152-5001

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